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Leachability of Metals from Mineral Processing Waste

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Leachability of Metals from Mineral Processing Waste

by

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Lawrence W. Reiter, Acting Director.
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Abstract

This report evaluates the leaching of oxoanions and other materials from mineral processing wastes, using the TCLP test as well as several other alternative leaching tests (Generalized Acid Neutralization Capacity (GANC), Constant pH 5.0 Leaching Test, Constant pH Leaching Test at Various pHs, and Variable Mass Leaching Test).

Three actual mineral processing wastes were selected for evaluation. These wastes came from (1) fluvial tailings from the Arkansas River, three miles from the mining district in Leadville, CO, (2) the Anaconda copper mine in Yerington, NV, and (3) from a slag pile at a lead and zinc smelter near the village of Dearing, Montgomery County, in southeastern Kansas.

We found that mineral processing wastes vary widely in composition and characteristics. The three samples tested were soil-like and varied in characteristics, with one being classified as a loamy sand, one a sandy loam, and the third a silty sand. Unfortunately, since this study focused on leaching of oxoanions, none of the samples contained significant quantities of these materials. The Yerington, NV sample was the highest, with 209 mg/kg As and 156 mg/kg Se. All three samples had TCLP leachate concentrations well below the allowable limits, except for cadmium in the Dearing waste. The Leadville and Yerington wastes would be deemed suitable for municipal landfill disposal, based on the TCLP test. The amount leached during the TCLP test varied from element to element and from waste to waste, but variations were relatively minor. Less than 10 percent of most metals leached. For the oxoanions, very little arsenic, cadmium or vanadium leached, while the amount of molybdenum and selenium leached varied from waste to waste. However, the concentrations of these last two in the wastes were very low to begin with. Oxoanion leaching reached an equilibrium fairly quickly, generally within one day. There was an immediate high degree of leaching, probably caused by surface washoff, followed by a constant arsenic concentration. Thus, the 18-24 hour leaching time used in the TCLP test is probably appropriate. In general, the amounts of metals leached under the Constant pH 5.0 leaching test conditions and the TCLP leaching test are of the same order of magnitude, although there is some variability between them. The concentrations of oxoanions leached under the two leaching conditions are quite similar. Leaching tests run at several constant pH values between pH 3.0 and 9.0 were used to evaluate the influence of pH on metal leaching. Results indicate that 24 hours of leaching is sufficient, and that many of the elements were below detection limits at higher pH values. This is not surprising, because most metals have a lower solubility at pH values above neutral compared with below neutral, although this may not be the case for metals in the anionic form. Most of the oxoanions were also non-detectable, though, above pH 5.0.

Based on the results of this study, using this set of MPW wastes, it is concluded that the TCLP test is as adequate as any of the other methods studied for estimating potential risk from the leaching of MPW wastes. The test procedure is simpler than other available tests, and the results obtained from the TCLP test are comparable to those from other more demanding test procedures. The TCLP test pH of 5.0 appears to be appropriate for MPW wastes, as is the 18-24 hour leaching period. It must be reiterated, though, that two of the three wastes evaluated did not contain high levels of oxoanions, and the one that did exhibited a very low degree of leaching. Other wastes might exhibit different leaching behaviors. It is recommended that use of the TCLP test for mineral processing wastes be continued. A wider range of MPW wastes, that have been shown to leach oxoanions, should be evaluated, though.

This report was submitted by the University of Cincinnati (UC) in fulfillment of Contract No. 68-C7-0057 under the sponsorship of the United States Environmental Protection Agency (EPA). This report covers a period from August 2000 through November 2001; laboratory work was completed as of August 2001.

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1.0 Introduction

The purpose of this task order (Task Order No. 31, UC/EPA Contract No. 68-C7-0057) was to test several alternative leaching tests — 1) Constant pH 5.0 Leaching Test, 2) Constant pH Leaching Test at Variable pHs, 3) the Generalized Acid Neutralization Capacity (GANC) test and 4) the Variable Mass Leaching Test — against the Toxicity Characteristic Leaching Procedure (TCLP) test for leaching from mineral processing wastes (MPW). This project was developed because of concerns relative to using the TCLP test for solid wastes containing oxoanions (i.e., arsenate, chromate, selenate, vanadate). These elements, which are commonly present in the anionic form in the environment, have acted acted differently under the TCLP conditions than do the cationic forms for which the TCLP test was designed. Mineral processing wastes (MPW) often contain high levels of one or more of these oxoanions. Thus, this project was developed to evaluate the leaching of metal oxoanions in mineral processing wastes under several test conditions.

The null hypothesis stated in the Quality Assurance Protection Plan (QAPP) for this project is: "There is no difference in concentrations of oxoanions extracted by the control leach test (Toxicity Characteristic Leaching Procedure (TCLP)) and by the alternative leach tests, (Generalized Acid Neutralization Capacity (GANC), Constant pH Leaching Test, and Variable Mass Leaching Test), when used on mineral processing waste (MPW) for the measurement of leachability."

The primary objective of this project was to:

- determine whether other leaching tests will give results different from the TCLP test when testing the leachability of MPW.

Secondary objectives were to:

- determine whether other leaching tests are suitable for mineral processing wastes.
- characterize MPW.

The University of Cincinnati (UC) obtained MPW samples from three sites - Leadville, CO; Yerington, NV and Dearing, KS - for testing and evaluation. The MPW samples were collected at the sites, transported to the UC laboratory, and tested using the leach tests stated above. Special interest was focused on arsenic as it is an oxoion-forming element which has been reported to fail the TCLP test for leachability.

2.0 Background

Mineral Processing Waste (MPW) samples were collected from three different sites – Leadville, CO; Yerington, NV and Dearing, KS.

2.1 Leadville, CO MPW

The first MPW samples were provided by Mr. Michael Holmes, USEPA. The samples were collected from fluvial tailings from the Arkansas River, three miles from the mining district in Leadville, CO. They were reported to be high in metals (up to 5% lead and 14% zinc) and to have greater than 300 ppm arsenic. The samples were shipped from Colorado Mountain College by Professor Karmen Klima on November 10, 2000 and were received at UC on November 17, 2000.

At the UC laboratory the samples were sub-sampled using a soil splitter. MPW samples were removed from the transportation vessel and split repeatedly until representative samples of approximately 500 g were produced. A half-half splitter was used for sub-sampling. The 75-pound sample was first split into two halves. Then each half was split into equal halves. By repeating this process, sub-samples of approximately 500 g were produced and stored. The sub-samples were stored in glass jars with Teflon liners. Sub-samples of a small amount (100 g or less) were kept in plastic zippered sample bags. The jars and sample bags were kept in a dry, dark environment before being subjected to several leaching tests, including the TCLP test, the constant pH leaching test, the Generalized Acid Neutralization Capacity (GANC) test and the variable mass leaching test. Test results were compared and analyzed to determine if, for MPW, other leaching tests might give results different from the TCLP test.

2.2 Yerington, NV MPW

With help from Mr. David Reisman, USEPA, we received a variety of MPW samples (12 samples in all) from the Anaconda copper mine in Yerington, NV. Based on the information in the Chain of Custody forms, four MPW samples with potentially high oxoanion concentrations were chosen for digestion and preliminary analysis. This step was used to provide a primary screening of the 12 original samples so that the one MPW sample with the highest concentration levels of oxo-anion forming elements could be identified for further analysis. The sample selected was sub-sampled and analyzed as above.

2.3 Dearing, KS MPW

Near the end of the project, we received a third MPW sample from Dr. Souhail Al-Abed, USEPA. This sample came from a slag pile at a lead and zinc smelter near the village of Dearing, Montgomery County, in southeastern Kansas. Although the smelter is no longer in operation, heavy metals such as Pb and Cd that are contained in the slag are a matter of ongoing environmental concern, especially considering the effort and expense involved in the currently recommended remediation treatment of digging up contaminated soil and treating it as toxic waste. This sample was sub-sampled and analyzed by TCLP and Constant pH leaching procedures.

3.0 MPW Characterization

Prior to the leaching studies, the Leadville and Yerington MPW samples were characterized by UC and by Agvise Laboratories, Northwood, ND.

Total waste and chemical speciation analyses of the MPW samples were performed by Agvise Laboratories. These included density, particle size, percent organic matter, cations (Ca, Mg, Na, K), pH and alkalinity. Data generated for the Leadville and Yerington MPW samples by Agvise Laboratories are presented in Table 3-1 and Table 3-2. Table 3-3 lists the test procedures used by Agvise Laboratories. The actual Agvise reports are presented in Appendix Tables B-1 and B-2.

Table 3.1. Characterization of Leadville, CO MPW Sample — Agvise Laboratories

Percent Sand (2.0-0.05 mm)	86	
Percent Silt (0.05-0.002 mm)	6	
Percent Clay (<0.002 mm)	8	
USDA Textural Class (hydrometer)	Loamy Sand	
Bulk Density (disturbed)(gm/cc)	1.45	
Particle Density (gm/cc)	2.57	
Cation Exchange Capacity (meq/100 g)	13.6	
% Organic Matter (Walkley-Black)	1.0	
% Carbonates	0.2	
pH (1 g soil in 1 g water)	2.6	
Base Saturation Data		
Cation	Percent*	ppm**
Potassium	0.8	42
Calcium	47.6	1300
Magnesium	3.1	50
Sodium	1.1	33
Hydrogen	47.5	65

*meq cation/cation exchange capacity.
**From determination of ammonium acetate extractable calcium, magnesium, sodium and potassium in soil (Agvise SOP NUT.02.12) (Note: Cation Exchange. Capacity (meq/100 g) = sum of the meq/100 g for calcium+magnesium+sodium+potassium+hydrogen ions.

There was not enough time to do a complete characterization of the Dearing, KS waste. However, this waste has been previously characterized by others. Table 3-4 provides selected chemical and physical properties of similar soils from this site for the ≤2 mm soil fraction (Hettiarachchi et al., 2001)[1].

[1]Hettiarachchi, G.M., G.M. Pierzynski, and M.D. Ransom. 2001. In situ stabilization of soil lead using phosphorous. J. Environ. Qual. 30:1214-1221.

Table 3-2. Characterization of Yerington, NV MPW Sample — Agvise Laboratories

Percent Sand (2.0-0.05 mm)	57.0	
Percent Silt (0.05-0.002 mm)	41.0	
Percent Clay (<0.002 mm)	1.0	
USDA Textural Class (hydrometer)	Sandy Loam	
Bulk Density (disturbed)(gm/cc)	0.80	
Particle Density (gm/cc)	1.22	
Cation Exchange Capacity (meq/100 g)	18.9	
% Organic Matter (Walkley-Black)	4.9	
% Carbonates	0.0	
pH (Water)	3.1	
Base Saturation Data		
Cation	Percent*	ppm**
Potassium	0.8	56
Calcium	31.8	1200
Magnesium	15.0	340
Sodium	1.2	50
Hydrogen	51.3	97

*meq cation/cation exchange capacity.
**From determination of ammonium acetate extractable calcium, magnesium, sodium and potassium in soil (Agvise SOP NUT.02.12) Note: Cation Exchange Capacity (meq/100g) = sum of the meq/100 g for calcium+magnesium+sodium+potassium+hydrogen ions

Table 3-3. Test Procedures Used by Agvise Laboratories

Procedure	Primary Reference[1]
Physical[2]	
Bulk Density	NUT.02.10
Particle Density	NUT.02.10
Particle Size	NUT.02.32
Percent Organic Matter	NUT.02.04
Cations (Magnesium, Potassium, Calcium, Sodium)	NUT.02.12
pH	NUT.02.39
Alkalinity	

Notes:
[1]These procedures are based on Standard Methods for Soils established by the USDA and the Soil Society of America. NUT refers to Agvise's nutrient laboratory where the testing is conducted, and the numerical reference refers to their standard operating procedures.
[2]A total of 350 g of raw waste was submitted for the 7 analysis.

Table 3-4. Selected Chemical and Physical Properties of Dearing, KS MPW Soil Materials (≤ 2 mm fraction) Prior to Treatment Applications

Percent			Concentration, mg/kg				CEC cmol/kg	pH	Organic carbon g/kg
Sand	Silt	Clay	P	Cd	Pb	Zn			
76	20	4	360	189	9111	42592	45.6	6.0	37.1

Source: Hettiarachchi, G.M., G.M. Pierzynski, and M.D. Ransom, 2001. In situ stabilization of soil lead using phosphorus. J. Environ. Qual. 30:1214-1221.

Sample digestions and analyses for metals and oxoanions in all samples were performed at UC. The digestion method used was Method 3010 in SW 846 (see Table 3-5). Because of equipment problems with our atomic absorption spectrophotometer, we switched from the proposed AAS analysis to using ICP machines housed with, and operated by, the Department of Chemistry. Most metals were analyzed on a TJA AES atomic emission spectrophotometer using EPA Method 6010B. Arsenic was analyzed using EPA Method 6020B and an Agilent ICP-MS. Total metal analysis results for the three wastes are shown in Table 3-6.

Table 3-5. Leachate Measurement Procedures

Procedure	Primary Reference
Alkalinity	2320[1]
Acidity	2310[1]
pH	4500-H^+ B[1]
Metal of interest (Pb, Zn, Cu)	
Lead	SW-846 Method 7421
Zinc	SW-846 Method 7951
Copper	SW-846 Method 7211
Oxoanions (Sb, As, Cr, Mo, Se, V)	
Arsenic	SW-846 Method 7060A
Chromium	SW-846 Method 7191
Molybdenum	SW-846 Method 7481
Selenium	SW-846 Method 7740
Vanadium	SW-846 Method 7911

Note:
[1]Standard Methods for the Examination of Water and Wastewater, 19th ed. 1995.

Table 3-6. Composition of MPW Sample After Digestion — UC Analyses – see Appendix C, Tables C-1-3 for Detailed QC Information

Sample	Concentration, mg/kg dry MPW sample										
	As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville, CO	27	196.4	6.03	<0.001	35.26	7935	174	4.66	9.59	4.95	273.7
Yerington, NV	208.4	1566	26.3	63.3	1766	48770	1630	48.2	156.5	20.7	144.1
Dearing, KS	<0.01	260.8	5.3	<0.001	182.4	4080	47.8	10	<0.004	13.6	3822

3.1 Leadville, CO Waste Characterization

The Leadville, CO waste had the consistency of soil and was characterized as similar to a loamy sand, with small amounts of silt (6%) and clay (8%). It had a cation exchange capacity of only 1.45 gm/cc, and contained only 1.0% organic matter. Thus, its capacity to bind heavy metals was low. Its particle density was 2.57, similar to that of sand. Its pH, though, was a very acidic 2.6.

It was stated by USEPA personnel who provided us with this waste sample that it would be high in lead and zinc (up to 5% and 14%, respectively) and in arsenic (>300 ppm). Lead was not analyzed for in this sample, but the zinc (274 mg/kg) and arsenic (22 mg/kg) contents were found to be much lower than predicted. There was a considerable amount of iron (7,936 mg/kg). As these were fluvial tailings, it is possible that the sample received contained more sediment than the samples previously analyzed. It is possible that the sample received was not representative of the deposit at the site, or that many of the constituents had leached between when the samples were first analyzed several years ago and when they were supplied to us. Nevertheless, we continued to use this sample, as it did contain relatively significant oxoanion concentrations (As = 22 mg/kg, Se = 10 mg/kg). Little or no chromium, molybdenum or vanadium was present.

3.2 Yerington, NV Waste Characterization

Twelve samples were obtained from the Yerington, NV site. Based on preliminary analyses, one sample was selected for further testing. This sample was characterized as a sandy loam: 57.0 % sand, 41.0 % silt and only 1.0 % clay. The sample contained 4.9 % organic matter, and had a CEC of 18.9 meq/100 g. Its particle density was only 1.22.

The Yerington sample, which had a red color, contained large amounts of iron (48,780 mg/kg) and copper (1,766 mg/kg), which was expected for a copper mining waste. Oxoanion concentrations were much higher than in the Leadville MPW (Yerington: As = 209 mg/kg, Cr = 63 mg/kg, Mo = 48 mg/kg, Se = 157 mg/kg, V = 21 mg/kg).

3.3 Dearing, KS Waste Characterization

The Dearing, KS waste was not fully characterized, but it can be described as having the consistency of a loamy sand, with 76 % sand, 20 % silt and 4 % clay. The sample had an organic content of 3.7 %. Its CEC was 45.6 meq/100 g. Unfortunately, the sample contained very little oxoanions.

3.4 Quality Control

There were a few QC problems with the waste characterization data. These are discussed in Section 5.0. However, the overall results and trends are sufficient for the purposes of this study.

4.0 Leaching

As stated earlier, the MPW samples were sub-sampled according to the procedures laid out in the QAPP and then subjected to several leach tests, including the TCLP test, the Constant pH 5.0 Leaching Test, the Constant pH Leaching Test at Variable pHs, the Generalized Acid Neutralization Capacity (GANC) test, and the Variable Mass Leaching test. For each test, the test method used is presented in the appendix and the modifications to the method, if any, are presented in the following sections, together with the results.

4.1 TCLP

The Toxicity Characteristic Leaching Procedure (TCLP) is a standard method that EPA replies on for leachability testing. In this project, as stated in the QAPP, the TCLP test was performed following Method 1311 in SW 846. However, due to the limited quantity of the MPW samples, the amount of sample used for the TCLP in this project was reduced to 50 ± 0.5 g each. The amount of extracting liquid (TCLP fluid) was also reduced to approximately 1000 mL to keep the liquid/solid ratio at 20.

Triplicates were performed for the TCLP, i.e. the TCLP test was performed on three identical MPW samples. First, the MPW samples were sieved to reduce the particle size to less than 9.5 mm. Depending on the water pH value of the sample, TCLP fluid #1 or #2 was prepared for the extraction. A 50 ± 0.5 g sample was weighed and transferred into the TCLP jar. In order to maintain the liquid/solid ratio of 20, approximately 1000 mL of TCLP fluid was added into the jar. The TCLP jar was closed tightly before it was transferred to a tumbler for 18 hours agitation. After that, it was removed from the tumbler and the contents allowed to settle for a short period of time. Then the suspension was filtered with the TCLP filter paper. The filtered extract was acidified and stored in a refrigerator for analytical analysis.

TCLP results are presented in Table 4-1. TCLP QC data is presented in Appendix Tables C-4 to C-6 and is discussed in Section 5.0.

Table 4-1. TCLP Results for MPW Wastes

Sample	TCLP concentration, mg/L										
	As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville, CO	<0.01	23.09	0.02	<0.001	0.195	0.918	1.12	0.066	0.422	<0.004	4
Yerington, NV	0.02	154.3	0.024	0.285	5.822	1.312	12.48	0.03	0.087	0.167	0.396
Dearing, KS	<0.01	240.3	1.523	0.01	3.546	0.938	11.52	0.424	0.309	0.01	506.2
TCLP limit	5	-	1	5	-	-	-	-	1	-	-

4.1.1 TCLP Data Evaluation

As can be seen from Table 4-1, all three samples had TCLP leachate concentrations well below the allowable limits, except for cadmium in the Dearing waste. The Leadville and Yerington wastes would be deemed suitable for municipal landfill disposal for the considered contaminants, based on the TCLP test.

The TCLP results were also normalized to the amount of solid waste, and expressed as mg of constituent in the leachate per kg of waste material. These data are presented in Table 4-2. Based on the results in Tables 4-1 and 4-2, the percentages of each constituent leached under the TCLP conditions were determined (Table 4-3). The amount leached during the TCLP test varied from element to element and from waste to waste, but variations were relatively minor. Less than 10 percent of most metals leached. For

Table 4-2. Normalized TCLP Results for MPW Wastes

Sample	Concentration, mg/kg dry MPW sample										
	As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville, CO	0.06	457.3	0.39	<0.04	2.85	16.89	22.29	<1.10	7.24	<0.16	51.38
Yerington, NV	0.39	3099	0.46	5.14	116.4	26.24	249.6	<0.37	<1.01	3.33	7.92
Dearing, KS	<0.01	4805	30.46	<0.103	70.92	18.76	230.5	8.48	6.19	<0.14	10120

Table 4-3. Percent Leached During TCLP Test on MPW Wastes

Sample	Percent leached from MPW sample										
	As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville, CO	0.29	-	6.5	N/A	8.1	0.2	12.9	23.7	75.5	0	18.8
Yerington, NV	0.19	-	1.3	2.1	6.1	0	13.9	2	1.8	3.3	4.1
Dearing, KS	N/A	-	-	N/A	35.8	0.4	-	78	N/A	0	-

N/A = not applicable.
- = value > 100%.

the oxoanions, very little arsenic, cadmium or vanadium leached, while the amount of molybdenum and selenium leached varied from waste to waste. However, the concentrations of these last two in the wastes were very low to begin with.

4.2 Constant pH 5.0 Leaching Test

In order to be comparable to the TCLP test, the amount of MPW samples selected for use in the Constant pH 5.0 Leaching Test was also 50 ± 0.5 g. Samples were put into the reactor along with a magnetic stirrer. The initial pH value of the leachant was 5.0. Acid (0.1 N HNO_3) and/or base (0.1 N NaOH) were added into the reactor to maintain the pH value constant using a pH stat system. Continuous stirring was employed to keep the mixture homogeneous. The leachate was sampled at defined intervals. The sampling time and the volume of leachate were also recorded. Leachate samples were filtered and stored in the refrigerator for further analysis. Constant pH leaching test data for pH 5.0 leaching are provided in Tables 4-4, and 4-5 for the Leadville and Yerington wastes, respectively. This test was not performed on the Dearing waste, but similar results can be seen in Table 4-8.

4.2.1 Data Analysis

Examination of the data presented in Tables 4-4 and 4-5 shows that, in almost all cases, leaching reached an equilibrium fairly quickly, generally within one day. Figure 4-1 shows the amount of arsenic leaching as a function of time for the Leadville, CO and Yerington, NV MPW samples. There was an immediate high degree of leaching, probably caused by surface washoff, followed by a constant leachate arsenic concentration. Other wastes leached in a similar fashion. Thus, the 18-24 hour leaching time used in the TCLP test is probably appropriate. It can also be seen, though, that acid had to be continually added to maintain the pH 5.0 goal. The results from this test should be comparable to the TCLP test, in that they both have an objective of leaching at a pH of ~5.0. The difference between them is that the TCLP test has all of the required acid added at once, while the Constant pH test only adds acid as needed to maintain the desired pH. There is no guarantee that the final TCLP pH will be 5.0, because the amount of acid added according to the TCLP protocol may not be sufficient to maintain it at 5.0. On the other hand, there may be a surplus of acid at the beginning of the test. The constant pH test overcomes these potential problems.

Table 4-6 shows that, in general, the metals leached under the Constant pH conditions and the TCLP leaching test are of the same order of magnitude, although there is some variability between them. This variability may be due to the differences in equilibrium pH discussed above. The amounts of oxoanions leached under the two leaching conditions are quite similar.

4.3 Constant pH Leaching Test at Variable pH

In addition to the constant pH leaching test procedure described in the QAPP, another set of constant pH leaching tests was also performed for all three MPW samples. These MPW samples were tested at varying pH levels, with the pH level kept constant at the desired pH throughout the test. The pH levels chosen for this test were 3, 5, 7, and 9. Four identical 50 g MPW samples were put into four reactors, with the leachant inside maintained at pH levels of 3, 5, 7, and 9,

Table 4-4. Constant pH 5.0 Leaching Test data — Leadville, CO MPW

Time (hour)	Sqrt time ($hr^{1/2}$)	Total volume (mL)	Acid added (10^{-3} mol)	Amount leached (mg/kg MPW sample)										
				As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
0	0	1506.6	0.2	0	0	0	0	0	0	0	0	0	0	0
0.17	0.41	1507.2	0.6	2.22	667.8	0	0.77	0	6.31	5.58	0	0	0.15	30.75
1.08	1.04	1510.3	0.9	1.88	705.2	0.7	1.35	0.19	3.61	9.32	0	0	0.45	33.89
2.23	1.49	1512.1	1.4	0.99	409.8	1.45	2.71	-	2.72	11.21	0	0	0.9	16.97
3.38	1.84	1512.7	2.3	1.87	723.2	2.98	4.44	0.26	3.16	18.92	0	0	1.95	31.64
4.38	2.09	1512.9	2.6	0.97	324.8	-	4.82	0.5	3.16	9.81	0	0	1.35	12.34
5.25	2.29	1513.1	3.3	0.97	370	2.98	6.57	0.5	4.98	14.49	0	0	2.56	12.34
25.37	5.04	1514.4	4.5	0.97	837.8	2.98	7.15	0.75	4.08	21.51	4.49	0	2.86	21.63
49.17	7.01	1516.6	7.9	0.97	1332.6	2.99	8.71	0.5	4.08	27.4	4.5	0	3.32	28.62
72.75	8.53	1517.7	12.4	0.97	1182.4	2.99	9.88	0.69	5	26.48	9.99	3.42	4.38	21.68
128.12	11.32	1522.1	21.3	0.97	1533	3	8.35	0.82	5.01	28.21	0	2.39	3.79	24.84
174.03	13.19	1526	33.7	0.98	1760.2	3	10.13	0.69	7.3	30.87	4.53	0	4.4	24.91
222.45	14.91	1530.1	50.2	0.98	2006	3.01	10.16	0.95	8.7	33.81	15.62	0	4.72	28.1
246.47	15.7	1531.8	68.4	0.98	2028	3.02	10.75	1.14	8.71	31.69	4.54	0	5.64	25

Table 4-5. Constant pH 5.0 Leaching Test Data — Yerington, NV MPW

Time (hour)	Sqrt time ($hr^{1/2}$)	Total volume (mL)	Acid added (10^{-3} mol)	Amount leached (mg/kg MPW sample)										
				As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
0.00	0	1503.10	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.32	1505.10	2	0.96	2336.82	0.00	0.54	56.35	22.46	159.93	0.00	3.47	0.85	1.20
1.70	1.30	1509.10	7.3	0.97	2120.89	1.35	0.00	22.85	3.97	155.10	0.00	4.87	0.43	2.99
2.57	1.60	1509.90	13.4	0.97	2485.60	0.00	0.00	24.19	3.97	187.80	0.00	5.79	0.97	2.40
3.43	1.85	1510.30	19.9	0.98	696.25	0.54	0.00	5.49	1.32	49.92	0.00	0.00	0.00	0.00
4.55	2.13	1511.20	26.7	0.97	1600.36	0.27	0.00	13.58	2.65	125.03	0.00	2.32	0.10	0.00
5.82	2.41	1511.80	33.9	0.98	2174.27	0.00	0.00	17.85	3.31	170.74	0.00	7.20	0.32	0.00
29.08	5.39	1516.60	42.9	0.99	2400.17	1.35	0.00	13.58	2.00	207.37	0.00	9.54	0.00	0.00
54.98	7.42	1518.80	52.1	0.99	1664.91	0.27	0.69	8.86	6.66	147.17	0.00	10.49	0.75	1.21
77.5	8.80	1521.20	58.9	1.00	1802.01	1.36	0.41	6.91	1.33	163.16	0.00	9.81	0.86	0.00
127.03	11.27	1530.80	63.3	1.00	2112.81	0.28	0.00	6.36	1.34	196.89	0.00	18.80	0.87	0.00
164.03	12.81	1535.50	70.4	1.01	1914.15	0.00	0.00	5.63	0.00	178.70	0.00	16.50	0.55	0.61
212.95	14.59	1538.60	77	1.00	895.77	1.37	0.00	2.39	2.02	82.25	0.00	7.56	0.76	0.61
236.60	15.38	1539.8	83.6	1.02	1118.82	0.28	0.00	3.39	0.00	104.61	0.00	14.42	0.76	0.00

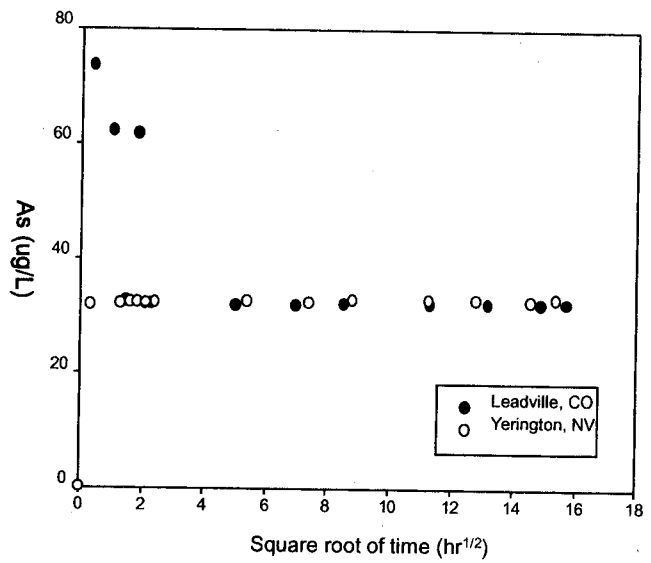

Figure 4-1. Arsenic leaching as a function of time at pH 5.0 - Leadville, CO and Yerington, NV MPWs.

Table 4-6. Comparison of TCLP and pH 5.0 Constant pH Leaching Results

Sample	Leachate concentration, mg/kg dry MPW sample										
	As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville - TCLP	0.06	457.3	0.39	<0.04	2.85	16.89	22.29	<1.10	7.24	<0.16	51.38
Leadville - pH 5.0	0.97	837.8	2.98	7.15	0.75	4.08	21.51	4.49	<1.0	2.86	21.63
Yerington- TCLP	0.39	3099	0.46	5.14	116.4	26.24	249.6	<0.37	<1.01	3.33	7.92
Yerington- pH 5.0	0.99	2400.00	1.35	0.00	13.58	2.00	207.40	0.00	9.54	0.00	0.00

respectively, using a pH stat system. Acid (HNO_3) and/or base (NaOH) were added into the reactors as necessary to keep the pH levels constant. The resulting leachates were sampled at selected time intervals. These samples were filtered and refrigerated for analysis. Results of the Constant pH Leaching Test at the selected pH values are presented in Tables 4-7 to 4-9.

4.3.1 Data Analysis

The Constant pH leaching test results under different leachant pH conditions (Tables 4-7 to 4-9) can be used to evaluate the influence of pH on metal leaching. Results for 24 hours of leaching are summarized in Table 4-10. Many of the elements were non-detectable at higher pH values. This is not surprising, because most metal cations have a lower solubility at pH values above neutral compared with below neutral. Most of the oxoanions were also below their detection limits (D.L.: 1 μg/L As, 1 μg/L Mo, 2 μg/L Se, 4 μg/L V) when the pH was above 5.0.

4.4 GANC Test

The GANC test performed in this project followed the standard method stated in the QAPP. MPW samples were dried, ground and sieved to 9.5 mm or less. A total of 63 samples of 1.000 ± 0.005 g were put in triplicate into HDPE bottles containing the appropriate leachant at 21 different pH levels. All the bottles were closed tightly and tumbled for 48 hours. The pH values of the leachates were then measured. Results are presented in Tables 4-11 and 4-12 for the Leadville, CO and Yerington, NV MPWs and are also plotted in Figures 4-2 and 4-3, respectively. The GANC test was not performed on the Dearing, KS sample.

The results presented indicate that the samples had essentially no acid neutralization capacity.

Table 4-7. Constant pH Leaching Test Data at Several pH Values— Leadville, CO MPW

	Time (hr)	Leachate concentration, mg/L										
		As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
pH=3	0.1	<0.01	3.666	<0.01	<0.01	<0.01	3.763	<0.01	<0.01	<0.01	<0.01	1.211
	3.0	<0.01	6.684	<0.01	<0.01	0.063	4.103	0.070	<0.01	<0.01	<0.01	1.290
	6.0	<0.01	7.009	<0.01	<0.01	0.029	3.664	0.120	<0.01	<0.01	<0.01	1.290
	9.0	<0.01	7.808	<0.01	<0.01	0.047	3.642	0.232	<0.01	<0.01	<0.01	1.245
	12.0	<0.01	7.986	<0.01	<0.01	0.045	3.686	0.254	<0.01	<0.01	<0.01	1.290
	24.0	<0.01	8.193	<0.01	<0.01	0.063	2.830	0.961	<0.01	<0.01	<0.01	1.290
	36.0	<0.01	8.429	<0.01	<0.01	0.065	2.710	0.310	<0.01	<0.01	<0.01	1.290
pH=5	0.1	<0.01	6.477	<0.01	<0.01	<0.01	0.362	0.354	<0.01	<0.01	<0.01	1.370
	3.0	<0.01	9.465	<0.01	<0.01	<0.01	0.307	0.505	<0.01	<0.01	<0.01	1.370
	6.0	<0.01	9.731	<0.01	<0.01	<0.01	0.252	0.466	<0.01	<0.01	<0.01	1.370
	9.0	<0.01	9.820	<0.01	<0.01	<0.01	0.143	0.466	<0.01	<0.01	<0.01	1.370
	12.0	<0.01	9.879	<0.01	<0.01	<0.01	0.340	0.454	<0.01	<0.01	<0.01	1.370
	24.0	<0.01	9.346	<0.01	<0.01	<0.01	0.143	0.438	<0.01	<0.01	<0.01	1.350
	36.0	<0.01	9.494	<0.01	<0.01	<0.01	0.384	0.404	<0.01	<0.01	<0.01	1.350
pH=7	0.1	<0.01	4.881	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.715
	3.0	<0.01	7.426	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.893
	6.0	<0.01	7.218	<0.01	<0.01	<0.01	0.066	<0.01	<0.01	<0.01	<0.01	0.953
	9.0	<0.01	6.716	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.457
	12.0	<0.01	6.656	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.417
	24.0	<0.01	5.029	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.429	<0.01	1.965
	36.0	<0.01	5.680	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.179
pH=9	0.1	<0.01	4.970	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.429
	3.0	<0.01	10.320	<0.01	<0.01	<0.01	0.022	0.061	<0.01	<0.01	<0.01	0.099
	6.0	<0.01	9.760	<0.01	<0.01	<0.01	0.450	<0.01	<0.01	<0.01	<0.01	0.139
	9.0	<0.01	8.964	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.020
	12.0	<0.01	8.165	<0.01	<0.01	<0.01	0.077	<0.01	<0.01	<0.01	<0.01	0.040
	24.0	<0.01	8.402	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.139
	36.0	<0.01	7.396	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.159

Table 4-8. Constant pH Leaching Test Data at Several pH Values — Yerington, NV MPW

	Time (hr)	Leachate concentration, mg/L										
		As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
pH=3	0.1	0.210	45.260	<0.01	<0.01	8.035	0.779	11.420	<0.01	<0.01	<0.01	0.159
	3.0	0.223	42.660	<0.01	<0.01	8.432	0.976	11.320	<0.01	<0.01	<0.01	0.199
	6.0	0.131	54.730	<0.01	<0.01	12.160	1.733	15.490	<0.01	<0.01	<0.01	0.218
	9.0	0.137	45.820	<0.01	<0.01	10.440	1.602	13.050	<0.01	<0.01	<0.01	0.179
	12.0	0.230	45.170	<0.01	<0.01	10.790	1.832	13.020	<0.01	<0.01	<0.01	0.199
	24.0	0.399	69.040	<0.01	<0.01	16.940	3.302	20.290	<0.01	<0.01	<0.01	0.318
	36.0	0.364	62.740	<0.01	<0.01	16.370	3.489	18.880	<0.01	<0.01	<0.01	0.258
pH=5	0.1	0.028	60.880	<0.01	<0.01	8.838	0.351	15.810	<0.01	<0.01	<0.01	0.199
	3.0	0.044	59.250	<0.01	<0.01	9.625	0.505	16.410	<0.01	<0.01	<0.01	0.179
	6.0	0.055	62.860	<0.01	<0.01	10.550	0.538	17.850	<0.01	<0.01	<0.01	0.159
	9.0	0.058	64.490	<0.01	<0.01	10.970	0.614	18.750	<0.01	<0.01	<0.01	0.218
	12.0	0.039	65.820	<0.01	<0.01	9.641	0.143	19.080	<0.01	<0.01	<0.01	0.179
	24.0	0.060	64.610	<0.01	<0.01	9.985	0.516	19.650	<0.01	<0.01	<0.01	0.238
	36.0	0.059	64.840	<0.01	<0.01	8.960	0.384	19.520	<0.01	<0.01	<0.01	0.199
pH=7	0.1	0.025	36.590	<0.01	<0.01	0.083	<0.01	9.970	<0.01	<0.01	<0.01	0.003
	3.0	0.037	42.860	<0.01	<0.01	0.300	<0.01	13.230	<0.01	<0.01	<0.01	0.043
	6.0	0.055	41.180	<0.01	<0.01	0.354	<0.01	12.960	<0.01	<0.01	<0.01	0.043
	9.0	0.063	41.000	<0.01	<0.01	0.300	<0.01	13.280	<0.01	<0.01	<0.01	0.102
	12.0	0.030	46.330	<0.01	<0.01	0.141	<0.01	15.420	<0.01	<0.01	<0.01	0.082
	24.0	0.081	43.340	<0.01	<0.01	0.311	<0.01	14.770	<0.01	<0.01	<0.01	0.102
	36.0	0.115	40.880	<0.01	<0.01	0.073	<0.01	15.030	<0.01	<0.01	<0.01	0.063
pH=9	0.1	0.020	42.130	<0.01	<0.01	0.091	<0.01	11.570	<0.01	<0.01	<0.01	0.020
	3.0	0.053	40.170	<0.01	<0.01	0.068	<0.01	12.320	<0.01	<0.01	<0.01	0.040
	6.0	0.081	39.380	<0.01	<0.01	0.063	<0.01	13.390	<0.01	<0.01	<0.01	0.020
	9.0	0.103	36.240	<0.01	<0.01	0.052	<0.01	12.880	<0.01	<0.01	<0.01	0.020
	12.0	0.126	36.150	<0.01	<0.01	0.037	<0.01	13.990	<0.01	<0.01	<0.01	0.020
	24.0	0.161	32.750	<0.01	<0.01	0.036	<0.01	13.190	<0.01	<0.01	<0.01	<0.01
	36.0	0.198	23.550	<0.01	<0.01	0.034	<0.01	11.600	<0.01	<0.01	<0.01	0.020

Table 4-9. Constant pH Leaching Test Data atSeveral pH Values - Dearing, KS MPW

	Time (hr)	Leachate concentration, mg/L										
		As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
pH=3	0.0	0.203	<0.01	<0.01	<0.01	0.084	<0.01	<0.01	<0.01	<0.01	<0.01	0.003
	0.1	0.022	18.460	0.133	<0.01	3.580	0.292	1.434	<0.01	<0.01	<0.01	116.000
	3.0	0.012	43.370	0.588	<0.01	11.640	2.300	3.689	0.136	<0.01	<0.01	370.400
	6.0	0.012	51.560	0.722	<0.01	16.620	6.973	4.725	0.232	<0.01	<0.01	502.600
	9.0	0.011	65.790	1.008	<0.01	23.040	12.280	6.267	0.423	0.176	<0.01	682.300
	12.0	0.013	66.210	1.071	<0.01	24.640	14.960	6.613	0.423	0.245	<0.01	717.800
	24.0	0.012	75.230	1.277	<0.01	29.420	21.780	7.882	0.646	0.352	<0.01	881.200
	36.0	0.013	78.660	1.312	<0.01	33.910	28.300	8.517	0.646	0.399	<0.01	989.100
pH=5	0.0	0.115	0.057	0.025	<0.01	0.145	0.095	<0.01	0.009	<0.01	0.047	1.055
	0.1	0.012	13.780	0.070	<0.01	0.262	0.029	1.111	<0.01	<0.01	<0.01	36.830
	3.0	0.004	32.780	0.079	<0.01	0.259	<0.01	2.876	<0.01	<0.01	<0.01	59.110
	6.0	0.003	49.880	0.177	<0.01	0.569	<0.01	4.241	<0.01	<0.01	<0.01	106.000
	9.0	0.004	59.880	0.267	<0.01	0.677	0.018	4.809	<0.01	<0.01	<0.01	156.000
	12.0	0.003	63.070	0.374	<0.01	0.624	<0.01	4.931	<0.01	<0.01	<0.01	175.800
	24.0	0.004	67.270	0.419	<0.01	0.779	0.029	5.037	<0.01	<0.01	<0.01	191.200
	36.0	0.003	76.380	0.535	<0.01	0.813	<0.01	5.443	<0.01	<0.01	<0.01	232.700
pH=7	0.0	0.098	0.176	<0.01	<0.01	0.098	0.062	<0.01	0.264	<0.01	0.015	0.202
	0.1	0.012	1.300	<0.01	<0.01	0.006	<0.01	0.131	<0.01	<0.01	<0.01	0.380
	3.0	0.018	2.453	<0.01	<0.01	0.006	0.051	0.237	<0.01	<0.01	<0.01	0.321
	6.0	0.010	6.033	<0.01	<0.01	0.006	0.084	0.755	<0.01	<0.01	<0.01	1.472
	9.0	0.011	9.462	<0.01	<0.01	0.020	0.062	1.132	<0.01	<0.01	<0.01	2.703
	12.0	0.010	9.080	<0.01	<0.01	0.006	0.040	1.256	<0.01	<0.01	<0.01	2.524
	24.0	0.007	8.843	<0.01	<0.01	0.005	0.018	1.245	<0.01	<0.01	<0.01	1.194
	36.0	0.010	7.276	<0.01	<0.01	0.006	0.007	1.011	<0.01	0.045	<0.01	0.956

(continued)

Table 4-9. Continued

pH=9	0.0	0.076	0.057	<0.01	<0.01	0.058	0.018	<0.01	<0.01	<0.01	<0.01	0.023
	0.1	0.020	0.146	<0.01	<0.01	0.020	0.018	<0.01	<0.01	<0.01	<0.01	<0.01
	3.0	0.026	0.323	<0.01	<0.01	0.048	0.205	<0.01	<0.01	<0.01	<0.01	0.102
	6.0	0.033	0.057	<0.01	<0.01	0.066	0.281	<0.01	<0.01	<0.01	<0.01	0.261
	9.0	0.047	0.057	<0.01	<0.01	0.084	0.534	<0.01	<0.01	<0.01	<0.01	0.400
	12.0	0.051	<0.01	<0.01	<0.01	0.089	0.589	<0.01	<0.01	<0.01	<0.01	0.559
	24.0	0.063	0.057	<0.01	<0.01	0.106	1.115	<0.01	<0.01	<0.01	<0.01	0.837
	36.0	0.059	0.057	<0.01	<0.01	0.124	1.357	<0.01	<0.01	<0.01	<0.01	0.996

Table 4-10. Constant pH Leaching Data Summary

Sample	Leachate concentration, mg/L										
	As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville, CO											
TCLP	<0.01	23.487	0.02	<0.01	0.339	1.074	1.149	0.083	0.382	<0.01	2.362
pH = 3	<0.01	8.193	<0.01	<0.01	0.0632	2.83	0.961	<0.01	<0.01	<0.01	1.29
pH = 5	<0.01	9.346	<0.01	<0.01	<0.01	0.1426	0.4376	<0.01	<0.01	<0.01	1.35
pH = 7	<0.01	5.029	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.4292	<0.01	1.965
pH = 9	<0.01	8.402	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.139
Yerington, NV											
TCLP	20.849	156.032	0.019	0.072	5.871	1.172	12.284	0.052	0.149	0.037	0.298
pH = 3	0.399	69.04	<0.01	<0.01	16.94	3.302	20.29	<0.01	<0.01	<0.01	0.318
pH = 5	0.06	64.61	<0.01	<0.01	9.985	0.5156	19.65	<0.01	<0.01	<0.01	0.238
pH = 7	0.081	43.34	<0.01	<0.01	0.3114	<0.01	14.77	<0.01	<0.01	<0.01	0.102
pH = 9	0.161	32.75	<0.01	<0.01	0.0356	<0.01	13.19	<0.01	<0.01	<0.01	<0.01
Dearing, KS											
TCLP	<0.01	221.1	1.401	<0.01	3.262	0.863	10.6	0.39	0.285	<0.01	465.705
pH = 3	0.012	75.23	1.277	<0.01	29.42	21.78	7.882	0.6461	0.3524	<0.01	881.2
pH = 5	0.004	67.27	0.4185	<0.01	0.7793	0.0291	5.037	<0.01	<0.01	<0.01	191.2
pH = 7	0.007	8.843	<0.01	<0.01	0.005	0.0181	1.245	<0.01	<0.01	<0.01	1.194
pH = 9	0.063	0.0572	<0.01	<0.01	0.1063	1.115	<0.01	<0.01	<0.01	<0.01	0.837

Table 4-11. GANC Test Results — Leadville, CO MPW

Sample No.	Equiv./kg	Replicate #1			Replicate #2			Replicate #3			Average	
		Weight, kg	eq/kg	pH	Weight, kg	eq/kg	pH	Weight, kg	eq/kg	pH	eq/kg	pH
0	0	1.01	0.00	3.05	1.01	0.00	3.12	1.00	0.00	3.02	0.00	3.06
1	2	1.00	2.00	2.79	1.01	2.01	2.75	1.00	2.00	2.72	2.01	2.75
2	4	1.00	4.01	2.62	1.00	4.01	2.69	1.00	4.00	2.66	4.00	2.66
3	6	1.00	6.02	2.53	1.00	6.00	2.52	1.00	6.00	2.52	6.01	2.52
4	8	1.01	8.06	2.46	1.00	8.01	2.48	1.00	7.99	2.52	8.02	2.49
5	10	1.00	10.01	2.48	1.00	10.03	2.45	1.00	10.01	2.47	10.02	2.48
6	12	1.00	12.02	2.36	1.00	12.04	2.42	1.01	12.07	2.39	12.04	2.39
7	14	1.00	14.02	2.34	1.00	14.00	2.37	1.00	14.00	2.36	14.00	2.36
8	16	1.00	16.00	2.31	1.00	16.04	2.28	1.00	16.05	2.31	16.03	2.30
9	18	1.00	18.05	2.26	1.00	18.07	2.30	1.00	18.01	2.27	18.05	2.28
10	20	1.00	20.00	2.20	1.01	20.13	2.28	1.00	20.02	2.28	20.01	2.24
11	22	1.01	22.21	2.25	1.00	22.02	2.22	1.00	22.06	2.20	22.10	2.22
12	24	1.01	24.12	2.22	1.01	24.12	2.23	1.00	24.01	2.21	24.09	2.22
13	26	1.00	26.10	2.19	1.01	26.14	2.19	1.01	26.16	2.18	26.13	2.19
14	28	1.00	28.05	2.18	1.01	28.18	2.16	1.00	28.10	2.18	28.11	2.17
15	30	1.00	29.99	2.14	1.00	30.10	2.13	1.00	30.06	2.16	30.05	2.14
16	32	1.01	32.24	2.11	1.01	32.23	2.08	1.00	32.02	2.11	32.17	2.10
17	34	1.00	34.01	2.13	1.01	34.23	2.13	1.00	34.05	2.14	34.10	2.13
18	36	1.00	36.03	2.10	1.00	36.03	2.05	1.00	36.04	2.05	36.03	2.07
19	38	1.00	38.09	2.06	1.01	38.27	2.08	1.00	38.03	2.09	38.13	2.08
20	40	1.00	40.16	2.08	1.00	40.04	2.01	1.01	40.31	2.03	40.17	2.04

Table 4-12. GANC Test Results — Yerington, NV MPW

Sample No.	Equiv./kg	Replicate #1			Replicate #2			Replicate #3			Average	
		Weight	eq/kg	pH	Weight	eq/kg	pH	Weight	eq/kg	pH	eq/kg	pH
0	0	1.00	0.00	2.78	1.01	0.00	2.24	0.99	0.00	2.63	0.00	2.55
1	2	0.99	1.99	2.20	1.00	2.00	2.16	1.00	2.00	2.24	2.00	2.20
2	4	1.00	4.00	2.15	1.00	3.98	2.10	1.00	3.99	2.27	3.99	2.17
3	6	1.01	6.04	2.11	1.01	6.06	1.97	1.01	6.03	2.05	6.04	2.01
4	8	1.00	7.99	2.01	1.00	8.02	1.95	1.00	7.96	2.09	7.99	2.02
5	10	1.01	10.09	2.00	1.00	10.01	1.91	1.00	10.04	1.91	10.05	1.96
6	12	1.00	11.96	2.05	1.01	12.06	1.99	1.00	12.02	1.85	12.02	1.96
7	14	1.00	13.96	1.94	1.00	14.03	1.89	1.00	13.96	1.89	13.98	1.91
8	16	1.00	16.00	2.02	0.99	15.89	1.93	1.00	15.98	1.82	15.96	1.92
9	18	1.00	17.91	1.81	0.99	17.86	1.87	1.00	17.93	1.84	17.90	1.84
10	20	1.00	20.04	1.77	1.00	19.98	1.76	1.00	19.90	1.74	19.97	1.76
11	22	1.01	22.20	1.65	1.00	21.96	1.55	1.00	22.07	1.62	22.07	1.61
12	24	1.00	24.07	1.75	1.00	23.95	1.74	1.00	23.93	1.75	23.98	1.75
13	26	1.00	25.92	1.79	1.00	26.08	1.69	1.00	25.95	1.57	25.98	1.68
14	28	1.00	28.06	1.64	1.01	28.20	1.70	1.00	28.08	1.64	28.11	1.66
15	30	1.01	30.24	1.47	0.99	29.73	1.64	1.00	29.88	1.65	29.95	1.59
16	32	1.00	32.00	1.57	1.00	31.94	1.55	1.00	31.87	1.61	31.94	1.58
17	34	1.00	33.86	1.54	1.00	33.90	1.51	1.00	34.14	1.45	33.97	1.48
18	36	1.01	36.18	1.51	1.00	35.93	1.55	1.00	35.82	1.61	35.98	1.56
19	38	1.00	38.15	1.49	1.01	38.30	1.49	1.00	37.85	1.60	38.10	1.53
20	40	1.01	40.32	1.46	0.99	39.68	1.52	1.00	40.04	1.62	40.01	1.49

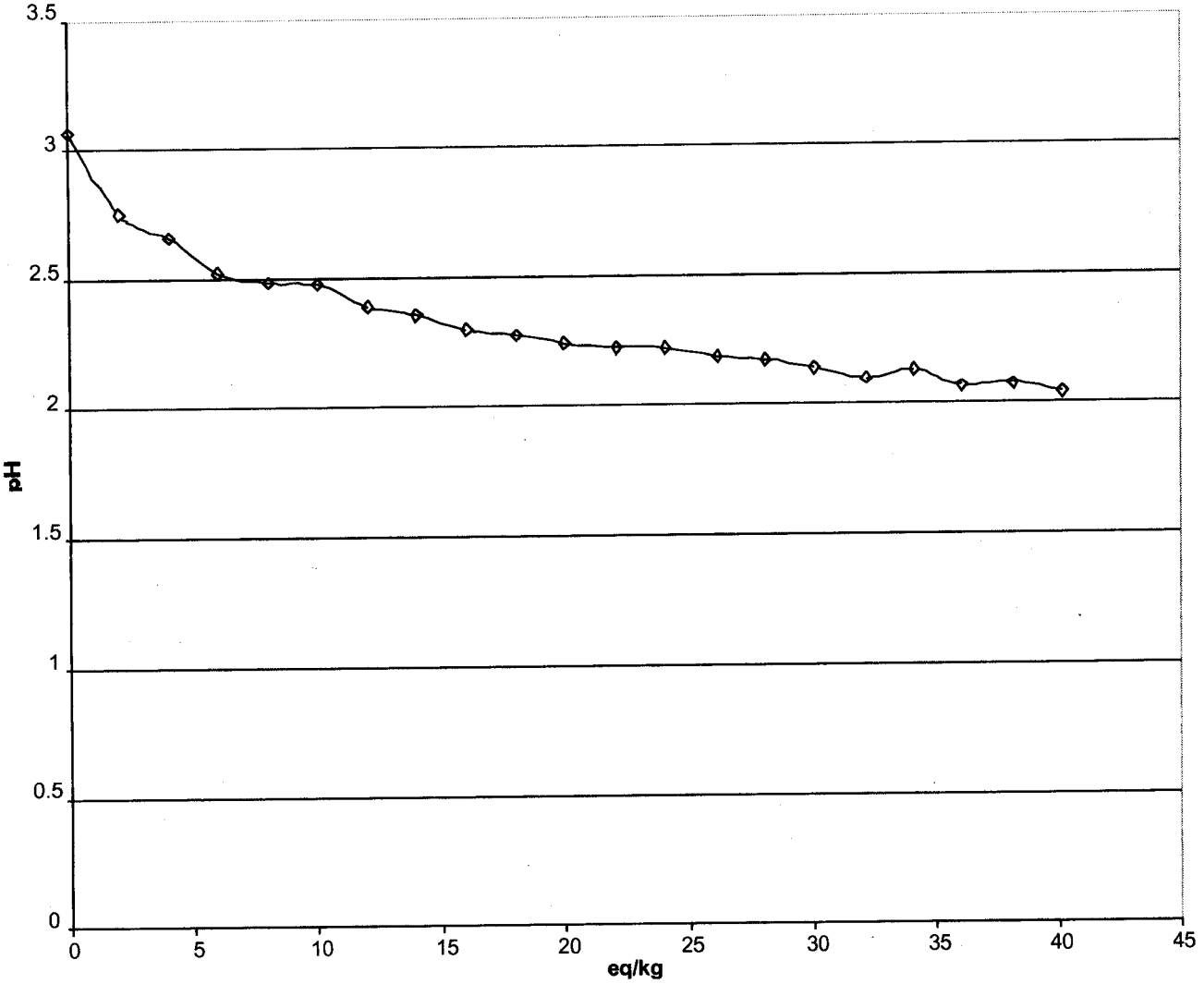

Figure 4-2. GANC test results — Leadville, CO MPW.

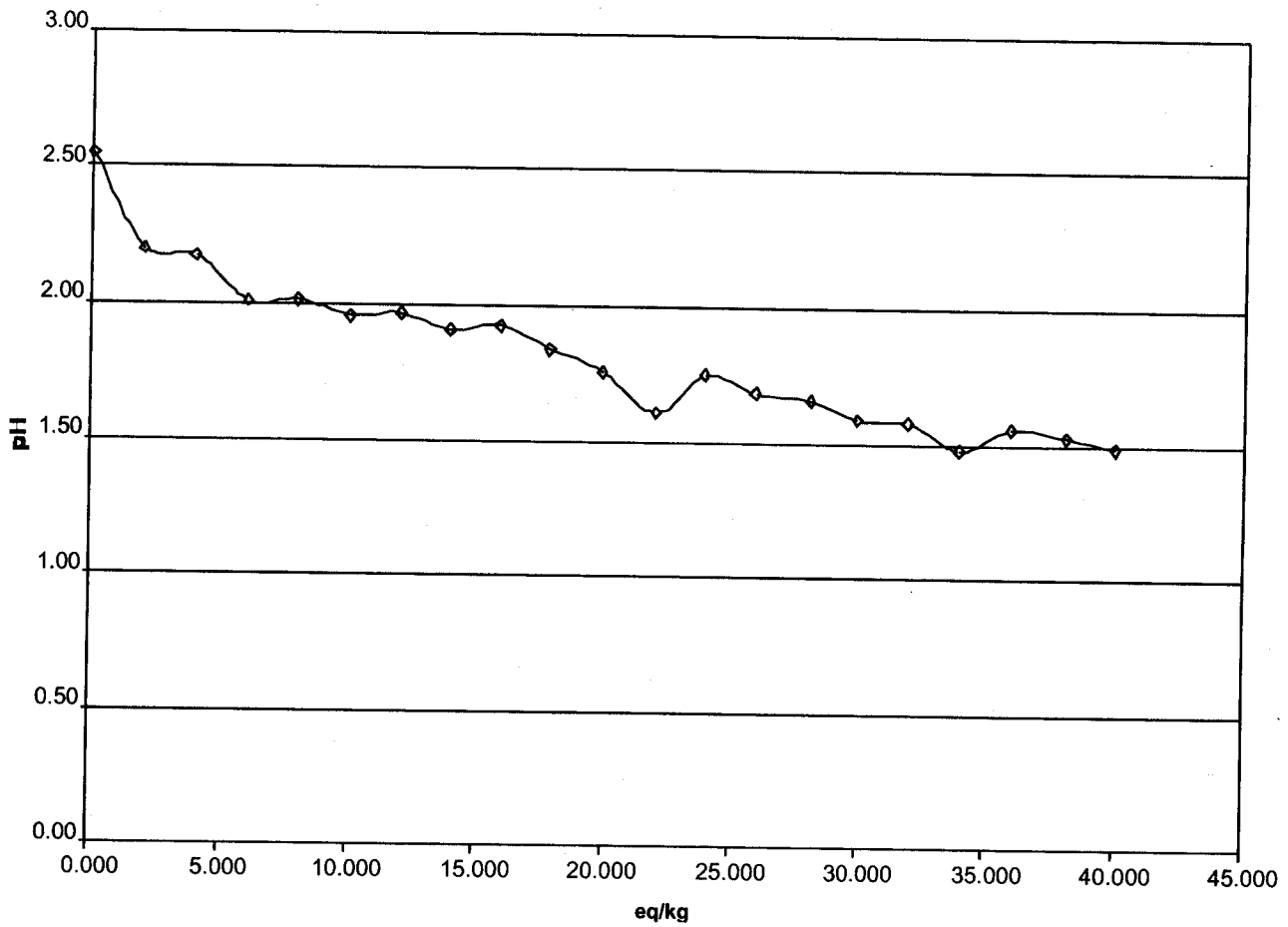

Figure 4-3. GANC test results — Yerington, NV MPW.

4.5 Variable Mass Leaching Test

The Variable Mass Leaching Test was investigated for use with the Leadville sample. However, this test is designed for use with permeable, but solid, wastes such as solidified/stabilized wastes. The test is performed to measure acid penetration rates into a solid and the resulting leaching rates. However, these MPW solids were granular in nature, and the acid did not penetrate. It was determined that the Variable Mass Leaching test was not applicable to MPW-type wastes and was not appropriate for this project. There was little of significance discovered in terms of leaching from MPW wastes. Therefore, this test was abandoned for this project. Nevertheless, the original data is provided in Appendix Table B-9.

5.0 Data Quality Discussion

The QC results can be found in the data files in the appendices, Tables C-1 to C-12. Certified QC standards were used throughout. During the analyses in this project, which included ICP-AES analysis, ICP-MS analysis and pH measurements, the QC checks indicated that the data quality in this project met the requirements in the QAPP most of the time, but there were lapses.

Table B-5 presents a summary of the metal analyses performed on the three MPW waste samples. This includes the average results for metals in the digestates, TCLP leachates, and constant pH leachates. The percent leached is also given. In addition, the relative deviations (R.D.) between the TCLP test results and the constant pH test results are provided. These indicate a large percent variation, but this is largely due to the small concentrations present. Small differences in concentration can lead to large relative deviations.

The QC data for these MPW samples is provided in Appendix Tables C-1, C-2 and C-3 for the Leadville, CO; Yerington, NV; and Dearing, KS samples, respectively. There is some question about the copper results for the Leadville, CO, waste because the check standard values were out of the range specified in the QAPP. The copper results may be biased high. However, copper was not an element of concern under analysis in this project. There was no precision or accuracy data for Leadville sample #4, but all others were acceptable. Except for a few blanks that were slightly high, all other results were within limits.

Table B-6 presents a summary of the ICP-AES results. As can be seen, the standard deviations between replicates are generally small.

Tables B-7 and B-8 present data from the GANC test on the Leadville and Yerington MPW wastes. Three replicates were run on each sample. A comparison of the data indicates that there was little variation between the three replicates.

Table B-9 presents all of the raw metals analysis data for all of the experiments. This includes all analyses, standards checks, blanks, etc.

Finally, Table B-10 summarizes the ICP data with measurement ranges. Again, there was very little variability between measurements.

Tables C-4, C-5 and C-6 present a QC analysis of the TCLP data for the Leadville, CO; Yerington, NV; and Dearing, KS, samples, respectively. The accuracy of these analyses and the blanks were in the acceptable range. There was one copper result for the Leadville MPW that was much too high, throwing the precision for this analysis off. It appears that this might be a decimal error. The result was ten times higher than the other replicates. If this is the case, the results become acceptable. Variability in copper, iron and selenium was higher than expected. Some of the Yerington measurements are suspect. Sample-to-sample comparisons are good, but some sample measurement precision and check standards are less than acceptable. For the Dearing MPW, sample-to-sample variability was acceptable for all but iron and selenium. Some of the blanks were a little high, which may have affected these results. The check standards accuracy was good.

Tables C-7 and C-8 show the QC data for the Leadville and Yerington samples subjected to the Constant pH 5.0 leaching test. In all cases, the blanks were high. Some of the check standards were less than acceptable for the Leadville MPW, but most were within range for the Yerington waste. There was no precision data available.

Tables C-9, C-10 and C-11 present QC data for the three wastes subjected to leaching at constant values of pH 3, pH 5, pH 7 and pH 9. There is one suspect blank data point for vanadium in the Leadville sample and one blank for the Yerington sample that registered zinc. All other data look fine, except that a few of the vanadium recovery values exceeded limits specified in the QAPP.

The QAPP minimum detection limits (0.05 - 4 μg/L) and precision (5%) and accuracy ($\pm$10-25%) standards set in the QAPP were much more stringent than is common for research of this type. More realistic values, such as those found in EPA SW 846 Method 6010B, would have been met in almost all cases. Thus, although the precision and accuracy of some of the data were below

QAPP standards and may be considered suspect, the magnitude of the values and the leaching trends determined would not have changed.

As noted above, some of the QC data did not meet the stringent limits specified in the QAPP. However, the metal concentrations present in the MPW samples were generally quite low and the resulting TCLP leachate concentrations were well below the allowable limits. It is not likely that more precise measurements would have caused the results to exceed the TCLP limits.

6.0 Conclusions

Based on the results presented, several conclusions can be made:

1. Mineral processing wastes vary widely in composition and characteristics. The three samples tested varied in physical characteristics, with one being classified as similar in texture to a loamy sand, one a sandy loam, and the third a silty sand. Organic contents varied from 1.0% to 4.9% Particle densities varied from 2.57 g/cc to 1.22 g/cc, and cation exchange capacity varied from 13.6 meq/g to 45.6 meq/g. Unfortunately, since this study focused on leaching of oxoanions, the samples contained smaller quantities of these materials than hoped for.The Yerington, NV sample was the highest, with 209 mg/kg As and 156 mg/kg Se.

2. All three samples had TCLP leachate concentrations for the elements studied well below the allowable limits, as shown in Table 4.1, except for cadmium in the Dearing waste. The Leadville and Yerington wastes would be deemed non-hazardous, and suitable for disposal in a municipal solid waste landfill, based on the TCLP test. The amounts leached during the TCLP test varied from element to element and from waste to waste, but variations were relatively minor. Less than 10 percent of most metals, including cadmium, leached. For the oxoanions, very little arsenic or vanadium leached, while the amount of molybdenum and selenium leached varied from waste to waste. However, the concentrations of these last two in the wastes were very low to begin with.

3. Mineral processing wastes vary widely in composition and characteristics. The three samples tested varied in physical characteristics, with one being classified as similar in texture to a loamy sand, one a sandy loam, and the third a silty sand. Organic contents varied from 1.0% to 4.9%. Particle densities varied from 2.57 g/cc to 1.22 g/cc, and cation exchange capacity varied from 13.6 meq/g to 45.6 meq/g. Unfortunately, since this study focused on leaching of oxoanions, the samples contained smaller quantities of these materials than hoped for. The Yerington, NV sample was the highest, with 209 mg/kg As and 156 mg/kg Se.

4. All three samples had TCLP leachate concentrations for the elements studied well below the allowable limits, as shown in Table 4.1, except for cadmium in the Dearing waste. The Leadville and Yerington wastes would be deemed non-hazardous, and suitable for disposal in a municipal solid waste landfill, based on the TCLP test. The amounts leached during the TCLP test varied from element to element and from waste to waste, but variations were relatively minor. Less than 10 percent of most metals, including cadmium, leached. For the oxoanions, very little arsenic or vanadium leached, while the amount of molybdenum and selenium leached varied from waste to waste. However, the concentrations of these last two in the wastes were very low to begin with.

5. Oxoanion leaching reached an equilibrium fairly quickly, generally within one day. There was an immediate high degree of leaching, probably caused by surface washoff, followed by a constant leachate arsenic concentration. Thus, the 18-24 hour leaching time used in the TCLP test is probably appropriate. In general, the metals leached under the Constant pH 5.0 conditions and the TCLP leaching test are of the same order of magnitude, although there is some variability between them. The amounts of oxoanions leached under the two leaching conditions are quite similar.

6. Leaching tests run at several constant pH values between pH 3.0 and 9.0 were used to evaluate the influence of pH on metal leaching. Results indicate that 24 hours of leaching is sufficient, and that many of the elements were non-detectable at higher pH values. This is not surprising, because most cationic metals are generally more soluble at lower pH. Most of the oxoanions were also non-detectable above pH 5.0. This is contrary to many previous studies that found increased arsenic leaching at higher pH. This may possibly have occurred here because of the relatively low arsenic concentrations present in the wastes.

7. The Variable Mass Leaching test and the SUC (Shrinking Unreacted Core) leaching tests are not suitable for mineral processing wastes because they are designed for use with permeable, but solid, wastes such as solidified/stabilized wastes.

The tests are performed to measure acid penetration rates into a solid and the resulting leaching rates. However, these MPW solids were granular in nature, and the acid did not penetrate. Consequently, they should not be used for particulate ($\leq$ 0.5 mm) MPW samples.

8. Based on the results of this study, using this set of MPW wastes, it is concluded that there is no difference in the amounts of contaminants leached between the leaching methods studied. The TCLP test procedure is simpler than other available tests, and the results obtained from the TCLP test are comparable to those from other, more demanding test procedures. The TCLP leaching solution pH of 5.0 appears to be appropriate for MPW wastes, as is the 18-24 hour leaching period. It must be reiterated, though, that two of the three wastes evaluated did not contain high levels of oxoanions, and the one that did exhibited a very low degree of leaching. Other wastes might exhibit different leaching behaviors.

7.0 Recommendations

The following recommendations can be made, based on the findings from this research:

1. It is recommended that use of the TCLP test for mineral processing wastes be continued, as it provides results comparable to those from other leaching protocols studied.

2. A wider range of MPW wastes, that have been shown to leach oxoanions, should be evaluated.

Appendices

Appendix A
Testing Procedures

Tables A-1 through A-3 list the methods used by the University of Cincinnati and Agvise Laboratories in this research. Most of these are standard EPA, ASTM or Corps of Engineers (COE) procedures and are referenced. Non-standard procedures are provided in the Quality AssuranceProject Plan.

Samples were immediately placed in a refrigerator for storage after sampling unless a refrigerator was not required. The parameters for sample preparation and storage are listed in Table A-4 for various matrices and analyses.

Table A-1. Physical Test Procedures Used by Agvise Laboratories

Procedure	Primary Reference[1]
Physical[2]	
Bulk Density	NUT.02.10
Particle Density	NUT.02.10
Particle Size	NUT.02.32
Percent Organic Matter	NUT.02.04
Cations (Magnesium, Potassium, Calcium, Sodium)	NUT.02.12
pH	NUT.02.39
Alkalinity	

Notes:

[1]These procedures are based on Standard Methods for Soils established by the USDA and the Soil Society of America. NUT refers to Agvise's nutrient laboratory where the testing is conducted, and the numerical reference refers to their standard operating procedures.
[2]A total of 350 g of raw waste was submitted for the 7 analyses.

Table A-2. Leachate Measurements by UC

Procedure	Primary Reference
Alkalinity	2320[1]
Acidity	2310[1]
pH	4500-H^+ B[1]
Metal of interest (Pb, Zn, Cu)	
Lead	SW-846 Method 7421
Zinc	SW-846 Method 7951
Copper	SW-846 Method 7211
Oxoanions (Sb, As, Cr, Mo, Se, V)	
Antimony	SW-846 Method 7041
Arsenic	SW-846 Method 7060A
Chromium	SW-846 Method 7191
Molybdenum	SW-846 Method 7481
Selenium	SW-846 Method 7740
Vanadium	SW-846 Method 7911

Note:
[1]Standard Methods for the Examination of Water and Wastewater, 19th ed. 1995.

Table A-3. Leaching Tests

Procedure	Primary Reference
TCLP	SW 846 Method 1311
Constant pH Leaching	Appendix A in QAPP
GANC Tests	Appendix B in QAPP
Variable Mass Leaching Test	Appendix C in QAPP

Table A-4. Sample Handling and Storage Conditions

Analyte	Sample Container	Sample Container Preparation	Sample Container Preservation	Sample Holding Time
Acidity	100 mL polyethylene beakers	One Time Use	N/A[1]	N/A[1]
Alkalinity	100 mL polyethylene beakers	One Time Use	N/A[1]	N/A[1]
MPW for Analysis	125 mL or larger (as available)	One Time Use	N/A[1]	Indefinite
MPW Stored	2-liter HDPE Jars with Teflon lids	One Time Use	None	Indefinite
Leachates	100 mL polyethylene with polypropylene screw cap	One Time Use	Acidify aqueous samples with HNO_3 to obtain a pH <2. Keep cool (4°C)	28 days
pH	100 mL polyethylene with polypropylene screw cap	One Time Use	N/A[1]	N/A[1]

Note:
[1]N/A—Samples consist of leachates generated or wastes with DI water added which are measured immediately.

Appendix B
Raw Data

All Leaching data obtained is listed in the following tables.

Table B-1. Agvise Laboratories Analyses for Leadville, CO MPW Sample

AGVISE LABORATORIES

Highway 15
P.O. Box 510
Northwood, ND 58267
(701) 587-6010
FAX (701) 587-6013
email: agvise@polarcomm.com
Homepage: agviselabs.com

AGVISE Soil Characterizatoin Report

University of Cincinnati	EPA Contract No	68-C7-0057
Peng Gong	Sample ID	MPW1-1
Dept. of Cival & Env.	AGVISE Reference No	6007974
PO Box 210071	AGVISE Lab No	76169
Cincinnati, OH 45221	Date Received	12/21/01
	Date Reported	1/12/01

Percent Sand	86
Percent Silt	6
Percent Clay	8
USDA Textural Class (hydrometer method)	Loamy Sand
Bulk Density (disturbed) gm/cc	1.45
Particle Density gm/cc	2.57
Cation Exchange Capacity (meg/100 g)	13.6
% Organic Matter (Walkley-Black)	1.0
% Carbonates	0.2
pH (Water)	2.6

Base Saturation Data

Cation	Percent	ppm
Potassium	0.8	42
Calcium	47.6	1300
Magnesium	3.1	50
Sodium	1.1	33
Hydrogen	47.5	65

Agricultural Testing

Table B-2. Agvise Laboratories Analyses for Yerington, NV MPW Sample

AGVISE LABORATORIES

25 ANNIVERSARY

604 Highway 15
P.O. Box 510
Northwood, ND 58267
(701) 587-6010
FAX (701) 587-6013
email: agvise@polarcomm.com
Homepage: agviselabs.com

AGVISE Soil Characterization Report

Submitted By:
UNIVERSITY OF CINCINNATI
DEPT OF CIVIL & ENV.
PO BOX 210071
CINCINNATI OH 45221-0

Results Reported To:
UNIVERSITY OF CINCINNATI
DEPT OF CIVIL & ENV.
PO BOX 210071
CINCINNATI OH 45221-0

Protocol/Study No = NA
Specimen ID = MPW2-1
Purchase Order = NA
Trial or Test No = 68-C7-0057

Depth = NA

Date Received = 7/ 2/01
Date Reported = 7/12/01

AGVISE Lab No = 15,809
AGVISE Ref No = 6,007,747

Percent Sand	57.0
Percent Silt	41.7
Percent Clay	1.0
USDA Textural Class (pipet method)	SANDY LOAM
Bulk Density (disturbed) gm/cc	0.80
Particle Density (gm/cc)	1.22
Porosity (%)	34.9
Cation Exchange Capacity (meg/100 g)	18.9
% Organic Matter (Walkley-Black)	4.9
% Carbonates	0.0
pH (Water)	3.1

Base Saturation Data

Cation	Percent	ppm
Potassium	0.8	56
Calcium	31.8	1200
Magnesium	15.0	340
Sodium	1.2	50
Hydrogen	51.3	97

Table B-3. Constant pH 5.0 Leaching Test Data — Leadville, CO

#	time (hour)	sqrt time ($hr^{1/2}$)	volume (mL)	acidity added (10^{-3} mol)	As leached (mg)	Ca leached (mg)	Cd leached (mg)	Cr leached (mg)	Cu leached (mg)	Fe leached (mg)	Mg leached (mg)	Mo leached (mg)	Se leached (mg)	V leached (mg)	Zn leached (mg)
			1500.00	0											
0	0.00	0	1506.60	0.20	0	0	0	0	0	0	0	0	0	0	0
1	0.17	0.41	1507.20	0.60	0.11084	33.3901	0	0.0387	0	0.31549	0.27923	0	0	0.00759	1.53747
2	1.08	1.04	1510.30	0.90	0.09388	35.2597	0.03484	0.06734	0.00926	0.18053	0.4662	0	0	0.02238	1.69466
3	2.23	1.49	1512.10	1.4	0.04931	20.4851	0.07273	0.13526	2.36957	0.13577	0.56027	0	0	0.04524	0.84834
4	3.38	1.84	1512.90	2.30	0.0934	36.1614	0.14895	0.222	0.01275	0.15813	0.94617	0	0	0.09771	1.58176
5	4.38	2.09	1512.70	2.60	0.04863	16.2408		0.24118	0.02512	0.15811	0.49043	0	0	0.06767	0.61708
6	5.25	2.29	1513.10	3.30	0.04855	18.5026	0.14897	0.32835	0.02512	0.249	0.72431	0	0	0.12819	0.61724
7	25.37	5.04	1514.40	4.50	0.04832	41.8896	0.1491	0.35769	0.03752	0.20375	1.07563	0.22456	0	0.14312	1.08149
8	49.17	7.01	1516.60	7.90	0.04845	66.631	0.14932	0.43567	0.02518	0.20405	1.36994	0.22489	0	0.1658	1.43096
9	72.75	8.53	1517.70	12.40	0.04862	59.1168	0.14942	0.4938	0.0345	0.24976	1.32421	0.49969	0.17111	0.21896	1.08384
10	128.12	11.32	1522.10	21.30	0.04889	76.6492	0.14986	0.41749	0.04121	0.25048	1.41037	0	0.11958	0.18938	1.24222
11	174.03	13.19	1526.00	33.70	0.04907	88.0097	0.15024	0.50641	0.03469	0.36523	1.54349	0.22628	0	0.22016	1.2454
12	222.45	14.91	1530.10	50.20	0.04922	100.322	0.15064	0.50777	0.04768	0.43511	1.69064	0.78108	0	0.23615	1.40479
13	246.5	15.70	1531.80	68.40	0.04941	101.404	0.15081	0.53773	0.05713	0.4356	1.58462	0.22714	0	0.28182	1.25013

Table B-4. Constant pH 5.0 Leaching Test Data — Yerington, NV

#	time (hour)	sqrt time ($hr^{1/2}$)	volume (mL)	alkalinity added (10^{-3} mol)	acidity added (10^{-3} mol)	As leached (mg)	Ca leached (mg)	Cd leached (mg)	Cr leached (mg)	Cu leached (mg)	Fe leached (mg)	Mg leached (mg)	Mo leached (mg)	Se leached (mg)	V leached (mg)	Zn leached (mg)
			1500	0	0											
0	0.00	0	1503.10	0.1	0.1	0	0	0	0	0	0	0	0	0	0	0
1	0.10	0.32	1505.10	2	2	0.04811	116.841	0	0.02709	2.81755		7.9963	0	0.17339	0.04274	0.0599
2	1.70	1.30	1509.10	7.3	7.3	0.04854	106.044	0.06731	0	1.14269	0.1986	7.75496	0	0.24327	0.02143	0.1497
3	2.57	1.60	1509.90	13.4	13.4	0.04873	124.28	0	0	1.20943	0.1987	9.38977	0	0.2896	0.04832	0.11989
4	3.43	1.85	1510.30	19.9	19.9	0.04879	34.8124	0.02688	0	0.27427	0.06615	2.49622	0	0	0	0
5	4.55	2.13	1511.20	26.7	26.7	0.04874	80.018	0.0136	0	0.67883	0.13268	6.25153	0	0.11606	0.00514	0
6	5.82	2.41	1511.80	33.9	33.9	0.04899	108.714	0	0	0.89226	0.16569	8.53683	0	0.35981	0.01603	0
7	29.08	5.39	1516.60	42.9	42.9	0.04946	120.009	0.06764	0	0.67883	0.09979	10.3687	0	0.47712	0	0
8	54.98	7.42	1518.80	52.1	52.1	0.04932	83.2454	0.01367	0.03432	0.44319	0.33322	7.35828	0	0.52459	0.03767	0.06045
9	77.50	8.80	1521.20	58.9	58.9	0.05004	90.1007	0.06785	0.02038	0.34531	0.06663	8.15789	0	0.49043	0.0432	0
10	127.03	11.27	1530.80	63.3	63.3	0.05017	105.641	0.01378	0	0.31779	0.06705	9.84427	0	0.93991	0.04347	0
11	164.03	12.81	1535.50	70.4	70.4	0.05056	95.7077	0	0	0.2813	0	8.93477	0	0.82487	0.02733	0.0304
12	212.95	14.59	1538.60	77	77	0.05023	44.7886	0.06862	0	0.1197	0.10124	4.11237	0	0.37788	0.03816	0.03046
13	236.60	15.38	1539.80	83.6	83.6	0.05085	55.9409	0.01386	0	0.16969	0	5.23039	0	0.72093	0.03819	0

Table B-5. Leachability of Mineral Processing Waste Report

		mg per 50g dry MPW sample										
		As	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Leadville, CO	digestion	1.101	9.820	0.3013	<0.01	1.763	396.8	8.700	0.2332	0.4795	0.2475	13.69
	TCLP	0.003182	22.86	0.01967	<0.01	0.1424	0.8445	1.125	0.05523	0.3618	<0.01	2.569
	leachable	0.2889%	232.8%	6.528%	N/A	8.080%	0.2129%	12.93%	23.68%	75.45%	N/A	18.77%
	SUC (final)	0.04839	99.30	0.1477	0.5266	0.05594	0.4266	1.552	0.2224	<0.01	0.2760	1.224
	leachable	4.394%	1011%	49.02%	N/A	3.173%	0.1075%	17.84%	95.38%	N/A	111.5%	8.945%
	R.D. (%)*	1421%	334.3%	650.9%	N/A	-60.73%	-49.49%	37.90%	302.7%	N/A	N/A	-52.35%
Yerington, NV	digestion	10.46	78.30	1.315	3.165	88.29	2439	81.50	2.412	7.825	1.033	6.652
	TCLP	0.01973	143.5	0.01748	0.06656	5.401	1.078	11.30	0.04802	0.1374	0.03386	0.274
	leachable	0.1887%	183.3%	1.330%	2.103%	6.118%	0.04421%	13.87%	1.991%	1.756%	3.277%	4.119%
	SUC (final)	0.04954	54.50	0.01350	<0.01	0.1653	<0.01	5.095	<0.01	0.7023	0.03720	<0.01
	leachable	0.4738%	69.60%	1.027%	N/A	0.1872%	N/A	6.252%	N/A	8.975%	3.601%	N/A
	R.D. (%)*	151.1%	-62.04%	-22.77%	N/A	-96.94%	N/A	-54.92%	N/A	411.1%	9.877%	N/A
Dearing, KS	digestion	<0.01	13.04	0.2643	<0.01	9.121	204.0	2.389	0.5000	<0.01	0.2680	191.1
	TCLP	0.0001291	221.1	1.401	<0.01	3.262	0.8628	10.60	0.3900	0.2845	<0.01	465.7
	leachable	<0.01	1696%	530.1%	N/A	35.77%	0.4229%	443.8%	78.00%	N/A	N/A	243.7%

* R.D. = (SUC - TCLP) / TCLP *100%
N/A = Not Applicable

Table B-6. ICP-AES Results for Leadville MPW Samples

	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
digest #1 (mg/L)	2.38	0	0	0.1488	47.97	0.5167	0	0	0	2.324
digest #2 (mg/L)	1.878	0	0	0.2291	65.24	0.9538	0	0	0	2.463
digest #3 (mg/L)	2.573	0.0037	0	0.2242	61.92	1.079	0	0	0	2.721
digest avg (mg/L)	2.277	0.001233	0	0.2007	58.3766667	0.849833	0	0	0	2.502667
digest std dev	0.292931	0.001744	0	0.036753	7.48240752	0.241042	0	0	0	0.164484
norm digest avg (mg/Kg)	455.4	0.246667	0	40.14	11675.3333	169.9667	0	0	0	500.5333
TCLP #1 A 1/2 (mg/L)	11.02	0.0052	0	0.0195	0.3345	0.5399	0.031	0.0675	0	1.272
TCLP #1 B 1/2 (mg/L)	11.26	0.0022	0	0.0083	0.3528	0.59	0	0.2005	0	1.305
TCLP #1 C 1/2 (mg/L)	11.35	0.0201	0	0.0299	0.3601	0.5752	0.0203	0.0956	0	1.292
TCLP #1 std dev 1/2	0.139284	0.007827	0	0.00882	0.01076796	0.021016	0.012856	0.057235	0	0.013573
TCLP #1 avg (mg/L)	22.42	0.018333	0	0.038467	0.69826667	1.136733	0.0342	0.2424	0	2.579333
TCLP #2 A (mg/L)	22.48	0.0164	0	0.0501	0.7348	1.05	0.0194	0.355	0	2.465
TCLP #2 B (mg/L)	22.82	0.0342	0	0.0501	0.7641	1.133	0.1256	0.5238	0	2.518
TCLP #2 C (mg/L)	22.76	0.0104	0	0.049	0.786	1.087	0	0.5034	0	2.504
TCLP #2 std dev	0.148174	0.010107	0	0.000519	0.02097496	0.033951	0.055207	0.075227	0	0.022425
TCLP #2 avg (mg/L)	22.68667	0.020333	0	0.049733	0.76163333	1.09	0.048333	0.460733	0	2.495667
TCLP #3 A (mg/L)	23.76	0.0164	0	0.847	1.093	1.136	0.0832	0.2578	0	2.637
TCLP #3 B (mg/L)	23.17	0.0223	0	0.0825	1.042	1.15	0.1044	0.4266	0	2.61
TCLP #3 C (mg/L)	23.53	0.0223	0	0.0879	1.086	1.161	0.1044	0.0619	0	2.65
TCLP #3 std dev	0.242808	0.002781	0	0.359123	0.02257334	0.010231	0.017351	0.089216	0	0.01666
TCLP #3 avg (mg/L)	23.48667	0.02033	0	0.339133	1.07366667	1.149	0.083167	0.382267	0	2.632333
norm #1 (mg/Kg)	448.4	0.366667	0	0.769333	13.9653333	22.73467	0.684	4.848	0	51.58667
norm #2 (mg/Kg)	453.7333	0.406667	0	0.994667	15.2326667	21.8	0.966667	9.214667	0	49.91333
norm #3 (mg/Kg)	469.7333	0.406667	0	6.782667	21.4733333	22.98	1.663333	7.645333	0	52.64667
norm TCLP avg (mg/Kg)	457.2889	0.393333	0	2.848889	16.8904444	22.50489	1.104667	7.236	0	51.38222
leach percentage	100.41%	159.46%		7.10%	0.14%	13.24%				10.27%
digest #4 (10g/100mL)	19.640	0.603	<0.01	3.526	793.500	17.400	0.466	0.959	0.495	27.370
re-run digest (mg/Kg)	196.40	6.03	<0.01	35.26	7935.00	174.00	4.66	9.59	4.95	273.70
leach percentage	233%	7%		8%	0.21%	13%	24%	75%	0%	19%

Table B-7. GANCTest Results for Leadville, CO WPW Waste

No.	Equivalents per Kilogram	Replicate #1			Replicate #2			Replicate #3			Average	
		weight	eq/kg	pH	weight	eq/kg	pH	weight	eq/kg	pH	eq/kg	pH
0	0	1.00908	0	3.05	1.00732	0	3.12	1.00043	0	3.02	0	3.063333
1	2	1.00099	2.00198	2.79	1.00499	2.00998	2.75	1.00170	2.0034	2.72	2.00512	2.753333
2	4	1.00166	4.00664	2.62	1.00141	4.00564	2.69	1.00013	4.00052	2.66	4.004267	2.656667
3	6	1.00256	6.01536	2.53	0.99989	5.99934	2.52	1.00081	6.00486	2.52	6.00652	2.523333
4	8	1.00736	8.05888	2.46	1.00088	8.00704	2.48	0.99920	7.9936	2.52	8.01984	2.486667
5	10	1.00055	10.0055	2.48	1.00318	10.0318		1.00079	10.0079	2.47	10.01507	2.475
6	12	1.00186	12.02232	2.36	1.00358	12.04296	2.42	1.00571	12.06852	2.39	12.0446	2.39
7	14	1.00111	14.01554	2.34	1.00013	14.00182	2.37	0.99967	13.99538	2.36	14.00425	2.356667
8	16	1.00028	16.00448	2.31	1.00249	16.03984	2.28	1.00294	16.04704	2.31	16.03045	2.3
9	18	1.00293	18.05274	2.26	1.00413	18.07434	2.3	1.00074	18.01332	2.27	18.0468	2.276667
10	20	0.99995	19.999	2.20	1.00625	20.125	2.28	1.00083	20.0166	2.28	20.0078	2.24
11	22	1.00946	22.20812	2.25	1.00076	22.01672	2.22	1.00276	22.06072	2.20	22.09519	2.223333
12	24	1.00518	24.12432	2.22	1.00517	24.12408	2.23	1.00031	24.00744	2.21	24.08528	2.22
13	26	1.00376	26.09776	2.19	1.00538	26.13988	2.19	1.00624	26.16224	2.18	26.13329	2.186667
14	28	1.00191	28.05348	2.18	1.00627	28.17556	2.16	1.00369	28.10332	2.18	28.11079	2.173333
15	30	0.99961	29.9883	2.14	1.00345	30.1035	2.13	1.00194	30.0582	2.16	30.05	2.143333
16	32	1.00742	32.23744	2.11	1.00728	32.23296	2.08	1.00077	32.02464	2.11	32.16501	2.1
17	34	1.00040	34.0136	2.13	1.00687	34.23358	2.13	1.00138	34.04692	2.14	34.09803	2.133333
18	36	1.00082	36.02952	2.10	1.00090	36.0324	2.05	1.00105	36.0378	2.05	36.03324	2.066667
19	38	1.00248	38.09424	2.06	1.00703	38.26714	2.08	1.00075	38.0285	2.09	38.12996	2.076667
20	40	1.00398	40.1592	2.08	1.00104	40.0416	2.01	1.00780	40.312	2.03	40.17093	2.04

Table B-8. GANC Test Results for Yerington, NV WPW Waste

No.	Equivalents per Kilogram	Replicate #1			Replicate #2			Replicate #3			Average	
		weight	eq/kg	pH	weight	eq/kg	pH	weight	eq/kg	pH	eq/kg	pH
0	0	0.998	0.000	2.78	1.007	0.000	2.24	0.994	0.000	2.63	0.000	2.55
1	2	0.994	1.988	2.20	1.002	2.004	2.16	1.002	2.004	2.24	1.999	2.20
2	4	0.999	3.996	2.15	0.995	3.980	2.100	0.998	3.992	2.27	3.989	2.17
3	6	1.007	6.042	-	1.010	6.060	1.97	1.005	6.030	2.05	6.044	2.01
4	8	0.999	7.992	2.01	1.003	8.024	1.950	0.995	7.960	2.09	7.992	2.02
5	10	1.009	10.090	2.00	1.001	10.010	1.91	1.004	10.040	-	10.047	1.96
6	12	0.997	11.964	2.05	1.005	12.060	1.99	1.002	12.024	1.85	12.016	1.96
7	14	0.997	13.958	1.94	1.002	14.028	1.89	0.997	13.958	1.89	13.981	1.91
8	16	1.000	16.000	2.02	0.993	15.888	1.93	0.999	15.984	1.82	15.957	1.92
9	18	0.995	17.910	1.81	0.992	17.856	1.87	0.996	17.928	1.84	17.898	1.84
10	20	1.002	20.040	1.77	0.999	19.980	1.76	0.995	19.900	1.74	19.970	1.76
11	22	1.009	22.198	1.65	0.998	21.956	1.55	1.003	22.066	1.62	22.073	1.61
12	24	1.003	24.072	1.75	0.998	23.952	1.74	0.997	23.928	1.75	23.984	1.75
13	26	0.997	25.922	1.79	1.003	26.078	1.69	0.998	25.948	1.57	25.983	1.68
14	28	1.002	28.056	1.64	1.007	28.196	1.70	1.003	28.084	1.64	28.112	1.66
15	30	1.008	30.240	1.47	0.991	29.730	1.64	0.996	29.880	1.65	29.950	1.59
16	32	1.000	32.000	1.57	0.998	31.936	1.55	0.996	31.872	1.61	31.936	1.58
17	34	0.996	33.864	-	0.997	33.898	1.51	1.004	34.136	1.45	33.966	1.48
18	36	1.005	36.180	1.51	0.998	35.928	1.55	0.995	35.820	1.61	35.976	1.56
19	38	1.004	38.152	1.49	1.008	38.304	1.49	0.996	37.848	1.60	38.101	1.53
20	40	1.008	40.320	1.46	0.992	39.680	1.52	1.001	40.040	-	40.013	1.49

Table B-9. ICP Raw Data

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	
Leadville 36993 TCLP	std chk 100 ppm	103.900	81.240	81.780	135.400	83.160	96.540	80.320	89.730	87.950	83.620	
	blank	N/D	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	N/D	
	std chk 100 ppm 2nd	104.900	81.880	82.470	137.300	83.660	97.000	81.130	90.590	88.680	84.580	
	digest #1	2.380	N/D	N/D	0.149	47.970	0.517	N/D	N/D	N/D	2.324	
	digest #2	1.878	N/D	N/D	0.229	65.240	0.954	N/D	N/D	N/D	2.463	
	digest #3	2.573	0.004	N/D	0.224	61.920	1.079	N/D	N/D	N/D	2.721	
	std chk 100 ppm 3rd	112.400	87.690	89.290	143.100	89.910	102.100	87.760	95.670	95.400	89.700	
	calibrate @ 70 ppm	50.020	49.950	50.160	51.360	50.030	50.170	50.100	50.100	49.890	49.880	
	70 ppm std chk	70.730	70.410	70.880	71.170	70.890	70.090	71.160	69.650	70.850	70.110	
	50 ppm std chk	51.880	50.740	50.600	47.320	50.220	49.940	51.780	52.050	50.530	50.160	
	TCLP #1 A 1:2 dilut.	11.020	0.005	N/D	0.020	0.335	0.540	0.031	0.068	N/D	1.272	
	TCLP #1 B 1:2 dilut.	11.260	0.002	N/D	0.008	0.353	0.590	N/D	0.201	N/D	1.305	
	TCLP #1 C 1:2 dilut.	11.350	0.020	N/D	0.030	0.360	0.575	0.020	0.096	N/D	1.292	
	TCLP #2 A	22.480	0.016	N/D	0.050	0.735	1.050	0.019	0.355	N/D	2.465	
	TCLP #2 B	22.820	0.034	N/D	0.050	0.764	1.133	0.126	0.524	N/D	2.518	
	TCLP #2 C	22.760	0.010	N/D	0.049	0.786	1.087	N/D	0.503	N/D	2.504	
	TCLP #3 A	23.760	0.016	N/D	0.847	1.093	1.136	0.083	0.258	N/D	2.637	
	TCLP #3 B	23.170	0.022	N/D	0.083	1.042	1.150	0.104	0.427	N/D	2.610	
	TCLP #3 C	23.530	0.022	N/D	0.088	1.086	1.161	0.062	0.462	N/D	2.650	
	70 ppm chk 2nd	73.070	72.880	72.900	75.550	73.02	73.620	73.690	73.290	73.100	72.240	
5/4/2001 VML Test	blank #1	N/D	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	N/D	
	blank #2	N/D	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	N/D	
	VML blank	N/D	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	0.014	
	VML 10g 1st sample	2.543	N/D	N/D	0.003	3.070	N/D	N/D	N/D	N/D	0.299	
	VML 10g 2nd sample	2.144	N/D	N/D	0.003	0.651	N/D	N/D	N/D	N/D	0.220	
	VML 50g 1st	8.253	N/D	N/D	0.023	1.528	0.169	N/D	N/D	N/D	0.736	
	VML 50g 2nd	8.563	N/D	N/D	0.043	1.172	0.155	N/D	N/D	N/D	0.736	
	VML 100g 1st	17.260	N/D	ND	0.062	3.185	0.692	N/D	N/D	N/D	2.096	
	VML 100g 2nd	18.030	N/D	N/D	0.061	2.576	0.667	N/D	N/D	N/D	2.165	
	digest #4 (10g/100mL)	19.64	0.6025	N/D	3.526	793.5	17.4	0.4664	0.959	0.4949	27.37	
	VML 10g 3rd	1.153	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	0.180	
	VML 50g 3rd	6.714	N/D	N/D	0.003	0.229	N/D	N/D	N/D	N/D	0.736	
	VML 100g 3rd	14.130	N/D	N/D	0.047	1.057	0.425	N/D	N/D	N/D	1.768	
	VML 0g 2nd	N/D	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	0.121	
	VML 0g 3rd	N/D	N/D	N/D	0.003	N/D	N/D	N/D	N/D	N/D	0.140	

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	
37018 Yerington	2nd MPW digt #1	28.500	0.395	N/D	17.940	156.000	44.940	0.004	0.084	0.180	0.270	
	2nd MPW digt #2	16.330	0.370	0.588	29.120	557.200	18.220	0.658	1.585	0.219	1.758	
	2nd MPW #3 (2.72)	196.500	0.089	0.050	1.125	256.200	69.890	0.100	0.387	0.742	0.855	
	2nd MPW digt #4	15.660	0.263	0.633	17.660	487.700	16.300	0.482	1.565	0.207	1.441	
	blank	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	0.111	
	Note: above 4 results were for 4 different Yerington wastes. They were used to select the waste to be used in this project.											
7/12/2001 Leadville	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As (ppb)
	blank w/2% HN03	0.5611	N/D	0.1853	0.0515	0.1791	0.4388	N/D	N/D	0.1515	0.0114	
	SUC 1-blank	0.8865	N/D	0.278	0.0645	0.2340	0.6086	N/D	N/D	0.1924	0.0213	0.1518
	SUC 1-1st time int	8.578	N/D	0.2871	0.0637	0.3107	0.6754	N/D	N/D	0.1942	0.4184	73.69
	SUC 1-2nd	8.992	0.0082	0.2938	0.0669	0.2778	0.7199	N/D	N/D	0.1977	0.4581	62.31
	SUC 1-3rd	5.590	0.0171	0.3097	0.6780	0.2669	0.7422	N/D	N/D	0.2031	0.2397	32.76
	SUC 1-4th	9.185	0.0350	0.3300	0.0678	0.2723	0.8341	N/D	N/D	0.2155	0.4283	61.87
	SUC 1-5th	4.614	2.016	0.3345	0.0710	0.2723	0.7255	N/D	N/D	0.2084	0.1801	32.3
	SUC 1-6th	5.132	0.035	0.3549	0.071	0.2943	0.7812	N/D	N/D	0.2227	0.1801	32.24
	SUC 1-7th	10.49	0.035	0.3617	0.0742	0.2833	0.8647	0.0522	N/D	0.2262	0.2993	32.06
	SUC 1-8th	16.14	0.035	0.3798	0.071	0.2833	0.9343	0.0522	N/D	0.2315	0.3886	32.1
	SUC 1-9th	14.41	0.035	0.3933	0.0734	0.2943	0.9232	0.1159	0.0381	0.2440	0.2993	32.19
	SUC 1-10th	18.37	0.0350	0.3752	0.0751	0.2943	0.9427	N/D	0.0266	0.2369	0.3390	32.27
	SUC 1-11th	20.91	0.0350	0.3956	0.0734	0.3217	0.9733	0.0522	N/D	0.2440	0.3390	32.31
	SUC 1-12th	23.65	0.0350	0.3956	0.0767	0.3382	1.007	0.1797	N/D	0.2476	0.3787	32.32
	SUC 1-13th	23.87	0.0350	0.4024	0.0791	0.3382	0.9816	0.0522	N/D	0.2582	0.339	32.41
	SUC 1-blank	1.277	0	0.3922	0.0824	0.3193	0.8439	0.0000	0.0000	0.2690	0.0274	1.518.E-04
	SUC 1-1st	12.35	N/D	0.4051	0.0814	0.4240	0.9366	N/D	N/D	0.2715	0.5374	7.369.E-02
	SUC 1-2nd	12.95	0.0115	0.4145	0.0854	0.3791	0.9983	N/D	N/D	0.2764	0.5884	6.231.E-02
	SUC 1-3rd	8.050	0.0241	0.4370	0.8659	0.3642	1.029	N/D	N/D	0.2839	0.3079	3.276.E-02
	SUC 1-4th	13.23	0.0492	0.4656	0.0866	0.3716	1.157	N/D	N/D	0.3013	0.5501	6.187.E-02
	SUC 1-5th	6.645	2.835	0.4720	0.0907	0.3716	1.006	N/D	N/D	0.2913	0.2313	3.230.E-02
	SUC 1-6th	7.391	0.0492	0.5007	0.0907	0.4016	1.083	N/D	N/D	0.3113	0.2313	3.224.E-02
	SUC 1-7th	15.11	0.0492	0.5103	0.0948	0.3866	1.199	0.0741	N/D	0.3162	0.3844	3.206.E-02
	SUC 1-8th	23.24	0.0492	0.5359	0.0907	0.3866	1.296	0.0741	N/D	0.3236	0.4991	3.210.E-02
	SUC 1-9th	20.75	0.0492	0.5549	0.0937	0.4016	1.280	0.1646	0.0564	0.3411	0.3844	3.219.E-02
	SUC 1-10th	26.46	0.0492	0.5294	0.0959	0.4016	1.307	N/D	0.0393	0.3312	0.4354	3.227.E-02
	SUC 1-11th	30.11	0.0492	0.5582	0.0937	0.4390	1.350	0.0741	N/D	0.3411	0.4354	3.231.E-02

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As (ppb)
7/12/2001 Leadville	SUC 1-12th	34.06	0.0492	0.5582	0.0980	0.4615	1.396	0.2552	N/D	0.3461	0.4864	3.232.E-02
	SUC 1-13th	34.38	0.0492	0.5678	0.1010	0.4615	1.361	0.0741	N/D	0.3610	0.4354	3.241.E-02
Leadville SUC Test results (in ppm)	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As
	SUC 1-blank	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
	SUC 1-1st	22.15	ND	0.0257	N/D	0.2093	0.1853	N/D	N/D	0.0050	1.020	0.07354
	SUC 1-2nd	23.35	0.0231	0.0446	0.0061	0.1195	0.3087	N/D	N/D	0.0148	1.122	0.06216
	SUC 1-3rd	13.55	0.0481	0.0895	1.567	0.0898	0.3705	N/D	N/D	0.0299	0.5610	0.03261
	SUC 1-4th	23.90	0.0985	0.1467	0.0084	0.1045	0.6254	N/D	N/D	0.0646	1.046	0.06172
	SUC 1-5th	10.74	5.671	0.1594	0.0166	0.1045	0.3242	N/D	N/D	0.0447	0.4079	0.03215
	SUC 1-6th	12.23	0.0985	0.2170	0.0166	0.1646	0.4787	N/D	N/D	0.0847	0.4079	0.03209
	SUC 1-7th	27.66	0.0985	0.2362	0.0248	0.1345	0.7103	0.1483	N/D	0.0945	0.7141	0.03191
	SUC 1-8th	43.93	0.0985	0.2873	0.0166	0.1345	0.9033	0.1483	N/D	0.1093	0.9435	0.03195
	SUC 1-9th	38.95	0.0985	0.3254	0.0227	0.1646	0.8725	0.3292	0.1127	0.1443	0.7141	0.03204
	SUC 1-10th	50.36	0.0985	0.2743	0.0271	0.1646	0.9266	N/D	0.0786	0.1244	0.8161	0.03212
	SUC 1-11th	57.67	0.0985	0.3319	0.0227	0.2393	1.011	0.1483	N/D	0.1443	0.8161	0.03216
	SUC 1-12th	65.57	0.0985	0.3319	0.0312	0.2844	1.105	0.5105	N/D	0.1543	0.9181	0.03217
	SUC 1-13th	66.20	0.0985	0.3510	0.0373	0.2844	1.034	0.1483	N/D	0.1840	0.8161	0.03226
	blank (2% HNO3)	0.9901	0.0439	0.3752	0.0775	0.2888	0.8230	0.0681	0.1186	0.2565	0.061	
	100 ppm check	160	84.08	116.6	29.86	102.9	41.92	106.2	59.73	101.9	65.12	
	SUC 2-blank	1.315	0.0484	0.4205	0.0840	0.3382	0.8536	0.1797	0.0419	0.2654	0.0908	0.1643
	SUC 2-1st	40.13	0.0350	0.4295	1.020	0.7112	3.510	0.1478	0.0995	0.2796	0.1107	32.13
	SUC 2-2nd	36.45	0.0707	0.4024	0.4626	0.4040	3.423	0.1478	0.1225	0.2725	0.1404	32.33
	SUC 2-3rd	42.47	0.0350	0.4205	0.4845	0.4040	3.963	0.1159	0.1378	0.2814	0.1305	32.44
	SUC 2-4th	12.84	0.0573	0.4137	0.1748	0.3601	1.680	0.1000	N/D	0.2654	0.0908	32.47
	SUC 2-5th	27.79	0.0529	0.4182	0.3086	0.3821	2.922	0.1159	0.0803	0.2671	0.0908	32.42
	SUC 2-6th	37.27	0.0484	0.4182	0.3791	0.3930	3.677	0.1000	0.1609	0.2707	0.0610	32.57
	SUC 2-7th	40.88	0.0707	0.4137	0.3078	0.3711	4.272	0.1159	0.1992	0.2636	0.0610	32.78
	SUC 2-8th	28.72	0.0529	0.4318	0.2299	0.4479	3.276	0.1797	0.2146	0.2778	0.1107	32.64
	SUC 2-9th	30.93	0.0707	0.4272	0.1975	0.3601	3.535	0.1159	0.2031	0.2796	0.0610	33.06
	SUC 2-10th	35.82	0.0529	0.4159	0.1878	0.3601	4.069	0.1797	0.3489	0.2796	0.0809	32.94
	SUC 2-11th	32.48	0.0484	0.4137	0.1756	0.3382	3.763	0.1637	0.3105	0.2743	0.1007	33.09
	SUC 2-12th	15.87	0.0707	0.4137	0.1229	0.3711	2.190	0.1000	0.1647	0.2778	0.1007	32.81
	SUC 2-13th	19.48	0.0529	0.4137	0.1391	0.3382	2.552	0.0681	0.2760	0.2778	0.0610	33.19
	SUC 2-13th REP	40.13	0.0707	0.4227	0.2040	0.3437	4.501	0.1797	0.5177	0.2796	0.0610	

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As
Leadville SUC Test results (in ppm)	100 ppm check	163.9	85.29	118.0	29.50	103.9	42.12	107.3	59.46	102.9	65.66	
	SUC 2-blank REP	1.389	0.0707	0.4182	0.0807	0.3382	0.907	0.1797	0.1724	0.2778	0.0511	
	SUC 2-1st REP	46.47	0.0529	0.4205	1.176	0.7660	3.880	0.1797	0.3028	0.2707	0.1404	
	LAST BLANK	1.034	0.0573	0.4024	0.0799	0.3162	0.854	0.1159	0.2568	0.2654	0.0610	
Yerington SUC test 7/16/01	SUC 2-blank	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
	SUC 2-1st	77.63	N/D	0.0180	1.872	0.7460	5.313	N/D	0.1152	0.0284	0.0398	0.03197
	SUC 2-2nd	70.27	0.0446	N/D	0.7572	0.1316	5.139	N/D	0.1612	0.0142	0.0992	0.03217
	SUC 2-3rd	82.31	N/D	N/D	0.8010	0.1316	6.219	N/D	0.1918	0.0320	0.0794	0.03228
	SUC 2-4th	23.05	0.0178	N/D	0.1816	0.0438	1.653	N/D	N/D	N/D	N/D	0.03231
	SUC 2-5th	52.95	0.0090	N/D	0.4492	0.0878	4.137	N/D	0.0768	0.0034	N/D	0.03226
	SUC 2-6th	71.91	N/D	N/D	0.5902	0.1096	5.647	N/D	0.2380	0.0106	N/D	0.03241
	SUC 2-7th	79.13	0.0446	N/D	0.4476	0.0658	6.837	N/D	0.3146	N/D	N/D	0.03262
	SUC 2-8th	54.81	0.0090	0.0226	0.2918	0.2194	4.845	N/D	0.3454	0.0248	0.0398	0.03248
	SUC 2-9th	59.23	0.0446	0.0134	0.2270	0.0438	5.363	N/D	0.3224	0.0284	N/D	0.0329
	SUC 2-10th	69.01	0.0090	N/D	0.2076	0.0438	6.431	N/D	0.6140	0.0284	N/D	0.03278
	SUC 2-11th	62.33	N/D	N/D	0.1832	N/D	5.819	N/D	0.5372	0.0178	0.0198	0.03293
	SUC 2-12th	29.11	0.0446	N/D	0.0778	0.0658	2.673	N/D	0.2456	0.0248	0.0198	0.03265
	SUC 2-13th	36.33	0.0090	N/D	0.1102	N/D	3.397	N/D	0.4682	0.0248	N/D	0.03303
	2% HN03 blank	0.5019		0.1536	0.0969	0.1626	0.3914			0.0589	1.739	
	2% HN03 after P.	0.6203		0.1966	0.071	0.1956	0.4805			0.1568	0.6368	
	2% HN03 w/H.	0.709		0.2124	0.071	0.2065	0.5446			0.1639	0.4581	
	100 ppm chk	122.9	65.49	90.72	24.17	80.58	32.67	81.67	45	79.93	52.49	
	100 ppm chk w/H.	125.8	65.85	91.54	23.52	80.84	32.32	82.45	44.85	80.35	52.22	
	C/C - calib.	1.023596	1.005497	1.009039	0.973107	1.003227	0.989287	1.009551	0.996667	1.005255	0.994856	
	TCLP #1	154.1	0.035	0.3413	5.794	1.38	12.33			0.2227	0.5772	
	TCLP #2	144.5	0.0261	0.4272	5.46	1.413	12.00			0.2298	0.5276	
	TCLP #3	151.5	0.0171	0.3368	5.705	1.282	12.43	0.0522	0.1647	0.228	0.4879	
	TCLP #1	161.3	0.035	0.3413	6.098	1.413	12.91			0.2369	0.4085	
	TCLP #2	152	0.0395	0.4453	5.747	1.468	12.79	0.0522	0.1647	0.2422	0.2993	
	TCLP #3	157.1	0.035	0.3549	5.983	1.336	13.00	0.0522	0.134	0.2298	0.3687	
	100 ppm chk	135.8	71.29	99.18	25.45	87.53	35.42	89.85	49.67	86.81	55.95	
	last blank	0.9161	0.035	0.3549	0.0726	0.2723	0.7506	0.1795	0.0189	0.2422	0.0610	
	#1/#1	1.046723	1	1	1.052468	1.023913	1.04704			1.063763	0.707727	
	#2/#2	1.051903	1.51341	1.042369	1.052564	1.038924	1.065833			1.05396	0.567286	

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As
Yerington SUC test 7/16/01	#3/#3	1.036964	2.046784	1.053741	1.048729	1.042122	1.045857	1	0.8136	1.007895	0.755688	
	BLANK	0.7682	0.0175	0.27575	0.0718	0.23395	0.61555			0.1995	0.0610	
	TCLP #1	160.5318	0.0175	0.0655	6.0262	1.17905	12.29445	0	0	0.0374	0.3475	
	TCLP #2	151.2318	0.0220	0.16955	5.6752	1.23405	12.17445	0.0522	0.1647	0.0427	0.2383	
	TCLP #3	156.3318	0.0175	0.07915	5.9112	1.10205	12.38445	0.0522	0.134	0.0303	0.3077	
	TCLP #3 repl.	156.0318	0.019	0.07235	5.870867	1.171717	12.28445	0.0522	0.14935	0.0368	0.297833	
8/15/01 Yerington var. pH	100 ppm std	215.2	199.5	215.6	183	213.9	193.8	204.6	184.4	209.5	193.8	
	Yer. sp3-b	0.1459	0.0521	0	0.1177	0.0839	0.0423	0	0	0.0396	0.0625	
	pH 3 - 1	45.41	0	0	8.153	0.8628	11.46	0	0	0	0.2213	
	pH 3-2, dil = 2:1	42.81	0	0	8.55	1.06	11.36	0	0	0	0.261	
	3-3	54.88	0	0	12.28	1.817	15.53	0	0	0	0.2809	
	3-4	45.97	0	0	10.56	1.686	13.09	0	0	0	0.2412	
	3-5	45.32	0	0	10.91	1.916	13.06	0	0	0.0004	0.261	
	3-6	69.19	0	0	17.06	3.386	20.33	0	0	0.004	0.3801	
	3-7	62.89	0	0	16.49	3.573	18.92	0	0	0	0.3206	
	100 ppm	219.1	201.9	219	183.7	217.4	195.2	208	188.3	212.9	196.9	
	5-b	0.1755	0.0879	0.0857	0.1955	0.1717	0.0702	0.2319	0	0.1179	0.1221	
	5-1	61.06	0	0.0043	9.033	0.5228	15.88	0	0	0.036	0.3206	
	5-2	59.43	0	0	9.82	0.6763	16.48	0	0	0.0218	0.3007	
	5-3	63.04	0	0	10.75	0.7093	17.92	0	0	0.0076	0.2809	
	5-4	64.67	0	0	11.17	0.786	18.82	0	0	0.004	0.3404	
	5-5	66	0	0	9.836	0.3143	19.15	0	0	0	0.3007	
	5-6	64.79	0	0	10.18	0.6873	19.72	0	0	0	0.3603	
	5-7	65.02	0	0	9.155	0.5557	19.59	0	0	0	0.3206	
	100 ppm	221	201.3	220.1	179.6	217.8	192.6	208.9	185.4	213.1	195.5	
	blank	0	0	0	0.0029	0	0	0	0	0	0	
	100 ppm	167.2	164.3	169.5	173.5	171.5	174.7	160.9	153.1	168.1	163.3	
	2sp7-b	0	0	0	0.0901	0	0	0	0	0	0	
	7-1	36.59	0	0	0.1728	0	9.97	0	0	0	0.0029	
	7-2	42.86	0	0	0.3901	0	13.23	0	0	0	0.0426	
	7-3	41.18	0	0	0.4436	0	12.96	0	0	0	0.0426	
	7-4	41	0	0	0.3901	0	13.28	0	0	0	0.1022	
	7-5	46.33	0	0	0.2312	0	15.42	0	0	0	0.0823	
	7-6	43.34	0	0	0.4015	0	14.77	0	0	0	0.1022	

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As
8/15/01 Yerington var. pH	7-7	40.88	0	0	0.1631	0	15.03	0	0	0	0.0625	
	100 ppm	195	183.5	194.4	178.6	194.6	185.4	184.8	169.9	190.9	179.7	
	2sp9-b	0.5601	0	0	0.1015	0	0	0	0	0	0.0228	
	9-1	42.69	0	0	0.1923	0	11.57	0	0	0	0.0426	
	9-2	40.73	0	0	0.1696	0	12.32	0	0	0	0.0625	
	9-3	39.94	0	0	0.1647	0	13.39	0	0	0	0.0426	
	9-4	36.8	0	0	0.1533	0	12.88	0	0	0	0.0426	
	9-5	36.71	0	0	0.1387	0	13.99	0	0	0	0.0426	
	9-6	33.31	0	0	0.1371	0	13.19	0	0	0	0.0228	
	9-7	24.11	0	0	0.1355	0	11.6	0	0	0	0.0426	
	blank	0.0572	0.1057	0.0495	0.1906	0.1607	0.0646	0.3275	0	0.1143	0.2213	
Leadville var. pH	blank	0	0	0	0.0029	0	0	0	0	0	0	
	100 ppm	81.81	81.03	83.88	88.82	85.12	85.79	78.92	74.37	83.47	81.13	
	blank	0	0.216	0	0.1075	0.0036	0	0.0044	0	0	0.0908	
	1sp3-b - dil. = 2:1	0	0	0	0.0058	0.062	0	0	0	0	0.1816	
	3-1	3.666	0	0	0.0058	3.825	0	0	0	0	1.393	
	3-2	6.684	0	0	0.069	4.165	0.0702	0	0	0	1.472	
	3-3	7.009	0	0	0.035	3.726	0.1203	0	0	0	1.472	
	3-4	7.808	0	0	0.0528	3.704	0.2316	0	0	0	1.427	
	3-5	7.986	0	0	0.0512	3.748	0.2539	0	0	0	1.472	
	3-5	8.518	0	0	0.0706	3.605	0.2929	0	0	0	1.472	
	3-6	8.193	0	0	0.069	2.892	0.961	0	0	0	1.472	
	3-7	8.429	0	0	0.0706	2.772	0.3096	0	0	0	1.472	
	100 ppm	197.1	185.3	198.3	181.5	198.3	185.8	186.9	172.5	194.5	182.4	
	5-b	0	0.0342	0	0.1404	0.062	0	0	0	0.0325	0.1022	
	5-1	6.477	0	0	0.1031	0.424	0.3541	0	0	0	1.472	
	5-2	9.465	0	0	0.0966	0.3692	0.5045	0	0	0	1.472	
	5-3	9.731	0	0	0.0836	0.3143	0.4655	0	0	0	1.472	
	5-4	9.82	0	0	0.0739	0.2046	0.4655	0	0	0	1.472	
	5-5	9.879	0	0	0.0706	0.4021	0.4543	0	0	0	1.472	
	5-6	9.346	0	0	0.069	0.2046	0.4376	0	0	0	1.452	
	5-7	9.494	0	0	0.0528	0.446	0.4042	0	0	0	1.452	
	100 ppm	203.2	191.4	205	181.8	204.3	188.6	192.7	177.3	200.1	187.3	
	1sp7-b	0.5601	0.0521	0	0.1436	0.0949	0.8218	0	0	0.0645	0.1618	
	7-1	5.441	0	0	0.0901	0.073	0.4265	0	0	0	0.8765	

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As
Leadville var. pH	7-2	7.986	0	0	0.082	0.0291	0.549	0	0	0	1.055	
	7-3	7.778	0	0	0.0674	0.1607	0.4599	0	0	0	1.115	
	7-4	7.276	0	0	0.069	0.073	0.4488	0	0	0	0.6184	
	7-5	7.216	0	0	0.0674	0.062	0.4488	0	0	0	0.5787	
	7-6	5.589	0	0	0.0479	0.0181	0.2483	0	0.4292	0	2.127	
	7-7	6.24	0	0	0.035	0.0291	0.4432	0	0	0	0.3404	
	100 ppm	211.7	196.3	212.2	180.8	211.1	190.4	200.4	181.6	206.7	191.6	
	blank	0	0.1057	0.0043	0.1501	0.0949	0	0.1044	0	0.0787	0.1419	
	1sp9-b	0.5601	0	0	0.0966	0.0401	0.5212	0	0	0	0.0426	
	9-1	5.53	0	0	0.035	0.0291	0.4154	0	0	0	1.472	
	9-2	10.88	0	0	0.0674	0.062	0.5824	0	0	0	0.1419	
	9-3	10.32	0	0	0.0652	0.4898	0.4878	0	0	0	0.1816	
	9-4	9.524	0	0	0.0187	0.0291	0.4376	0	0	0	0.0625	
	9-5	8.725	0	0	0.0204	0.1169	0.51	0	0	0	0.0823	
	9-6	8.962	0	0	0.0204	0.0401	0.4766	0	0	0	0.1816	
	9-7	7.956	0	0	0.0187	0.0291	0.4098	0	0	0	0.2015	
Dearing var. pH	100 ppm	202.6	189.8	202.2	179.8	201.8	188.5	191.4	176.3	197.7	185.7	
	3sp3-b - dil. 2:1	0	0	0	0.0836	0	0	0	0	0	0.0029	
	3-1	18.46	0.1325	0	3.58	0.2924	1.434	0	0	0	116	
	3-2	43.37	0.5884	0	11.64	2.3	3.689	0.1363	0	0	370.4	
	3-3	51.56	0.7224	0	16.62	6.973	4.725	0.2319	0	0	502.6	
	3-4	65.79	1.008	0	23.04	12.28	6.267	0.423	0.1759	0	682.3	
	3-5	66.21	1.071	0	24.64	14.96	6.613	0.423	0.245	0	717.8	
	3rdmpwdig1	32.28	0	0	25.29	551.4	4.888	0	0	0	538.1	
	3sp3-6	75.23	1.277	0	29.42	21.78	7.882	0.6461	0.3524	0	881.2	
	3-7	78.66	1.312	0	33.91	28.3	8.517	0.6461	0.3985	0	989.1	
	100 ppm	194.2	186.6	200.5	176	200.2	181.3	190.6	183.3	195.3	185.2	
	3sp5-b	0.0572	0.0253	0	0.1452	0.0949	0	0.0088	0	0.0467	1.055	
	5-1	13.78	0.07	0	0.262	0.0291	1.111	0	0	0	36.83	
	5-2	32.78	0.0789	0	0.2587	0	2.876	0	0	0	59.11	
	5-3	49.88	0.1772	0	0.5685	0	4.241	0	0	0	106	
	5-4	59.88	0.2666	0	0.6771	0.0181	4.809	0	0	0	156	
	5-5	63.07	0.3739	0	0.6236	0	4.931	0	0	0	175.8	
	3rdmpwdig2	39.97	0.3669	0	28.13	633.9	6.56	0	0	0	599.1	

(continued)

Table B-9. Continued

Sample	Description	Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn	As
Dearing var. pH	5-6	67.27	0.4185	0	0.7793	0.0291	5.037	0	0	0	191.2	
	5-7	76.38	0.5347	0	0.8133	0	5.443	0	0	0	232.7	
	100 ppm	209.8	196.1	210.4	179.6	209.5	190.5	200.8	182.9	204.8	190.2	
	3sp7-b	0.1755	0	0	0.0982	0.062	0	0.2637	0	0.0147	0.2015	
	7-1	1.3	0	0	0.0058	0	0.1314	0	0	0	0.3801	
	7-2	2.453	0	0	0.0058	0.051	0.2372	0	0	0	0.3206	
	7-3	6.033	0	0	0.0058	0.0839	0.755	0	0	0	1.472	
	7-4	9.462	0	0	0.0204	0.062	1.132	0	0	0	2.703	
	7-5	9.08	0	0	0.0058	0.0401	1.256	0	0	0	2.524	
	7-6	8.843	0	0	0.005	0.0181	1.245	0	0	0	1.194	
	7-7	7.276		0	0.0058	0.0071	1.011	0	0.0454	0	0.9559	
	100 ppm	212.9	197.9	212.3	179.3	211.8	191.4	203.3	186.9	207.1	192.6	
	3sp9-b	0.0572	0	0	0.0577	0.0181	0	0	0	0	0.0228	
		0.1459										
	9-3	0.0572	0	0	0.0658	0.2814	0	0	0	0	0.261	
	9-4	0.0572	0	0	0.0836	0.5337	0	0	0	0	0.4	
	9-5	0	0	0	0.0885	0.5886	0	0	0	0	0.5588	
	9-6	0.0572	0	0	0.1063	1.115	0	0	0	0	0.8368	
	9-7	0.0572	0	0	0.1242	1.357	0	0	0	0	0.9956	
	100 ppm	219.2	201.6	218.9	178.9	217.3	191.9	209.5	187.3	212.1	195.4	
	blank	0	0.07	0.0133	0.1696	0.1498	0	0.2956	0	0.1037	0.1221	
	3rdmpwdig3	43.27	0.9256	0.1728	28.75	647.5	8.961	1.1	0	0.5897	591.7	
	3rdtclp 1	2693	16.95	0.1479	38.43	28.94	127.8	4.78	4.133	0.1395	5605	
	3rdtclp 2	242.4	1.492	0	3.553	0.1078	11.46	0.4186	0.2031	0	510.3	
	3rdtclp 3	233.6	1.536	0	3.591	0.0749	11.49	0.4186	0.3489	0	498.8	
	blank	0.2061	0	0	0.0378	0.0749	0	0	0	0	1.431	
	100 ppm	105.8	98.57	106	89.8	105.8	95.64	101.2	93.53	103.2	96.78	

Table B-10. Arsenic Analyses

File	Physical Description	Low Conc.	High Conc.	File	Physical Description	Low Conc.	High Conc.
D.0826018	Blank	0.00	0.00	D.0826060	VS-2nd-3-pH3	73.48	79.88
D.0826019	0.5ppb Std	0.40	0.79	D.0826061	VS-2nd-3-pH5	33.11	36.19
D.0826020	2.5ppb Std	2.33	2.87	D.0826062	VS-2nd-3-pH7	36.19	39.53
D.0826021	25.0ppb Std	25.36	27.79	D.0826063	VS-2nd-3-pH9	48.54	52.88
D.0826022	250.0ppb Std	250.58	271.50	D.0826064	VS-3rd-4-pH3	5.26	6.06
D.0826023	VS-3rd-pH3	97.38	105.70	D.0826065	VS-3rd-4-pH5	1.54	2.02
D.0826024	VS-3rd-pH5	54.95	59.82	D.0826066	VS-3rd-4-pH7	5.16	5.93
D.0826025	VS-3rd-pH7	46.80	51.00	D.0826067	VS-3rd-4-pH9	22.37	24.56
D.0826026	VS-3rd-pH9	36.40	39.75	D.0826068	VS-2nd-4-pH3	76.59	83.39
D.0826027	VS-2ndB-pH3	10.70	11.93	D.0826069	VS-2nd-4-pH5	34.74	37.97
D.0826028	VS-2ndB-pH5	6.92	7.84	D.0826070	VS-2nd-4-pH7	39.56	43.31
D.0826029	VS-2ndB-pH7	9.60	10.74	D.0826071	VS-2nd-4-pH9	58.94	64.15
D.0826030	VS-2ndB-pH9	9.50	10.63	D.0826072	VS-3rd-7-pH3	6.05	6.90
D.0826031	VS-2nd-6-pH3	202.31	219.30	D.0826073	VS-3rd-7-pH5	1.42	1.89
D.0826032	VS-2nd-6-pH5	35.58	38.86	D.0826074	VS-3rd-7-pH7	4.83	5.58
D.0826033	VS-2nd-6-pH7	48.59	52.93	D.0826075	VS-3rd-7-pH9	28.26	30.98
D.0826034	VS-2nd-6-pH9	86.80	94.29	D.0826081	CAL Std-250ppb	249.70	270.60
D.0826035	VS-3rd-1-pH3	10.61	11.84	D.0826082	VS-2nd-4-pH3	208.93	226.50
D.0826036	VS-3rd-1-pH5	5.77	6.60	D.0826083	VS-2nd-4-pH3 dup	191.04	207.20
D.0826037	VS-3rd-1-pH7	5.81	6.64	D.0826084	VS-2nd-4-pH3 dup2	199.93	216.80
D.0826038	VS-3rd-1-pH9	9.32	10.44	D.0826085	NO FILE		
D.0826039	VS-2nd-1-pH3	111.48	121.00	D.0826086	VS-3rd-5-pH3	5.83	6.66
D.0826040	VS-2nd-1-pH5	20.53	22.57	D.0826087	VS-3rd-5-pH5	1.15	1.59
D.0826041	VS-2nd-1-pH7	21.65	23.79	D.0826088	VS-3rd-5-pH7	4.60	5.33
D.0826042	VS-2nd-1-pH9	19.1	21.02	D.0826089	VS-3rd-5-pH9	24.24	26.60
D.0826043	VS-2nd-7-pH3	185.32	200.90	D.0826090	VS-2nd-5-pH3	120.98	131.30
D.0826044	VS-2nd-7-pH5	35.10	38.34	D.0826091	VS-2nd-5-pH5	27.87	30.52
D.0826045	VS-2nd-7-pH7	64.74	70.46	D.0826092	VS-2nd-5-pH5	23.61	25.92
D.0826046	VS-2nd-7-pH9	104.46	113.40	D.0826093	VS-2nd-5-pH7	24	26.33
D.0826047	CAL Std-125ppb	126.04	136.80	D.0826094	VS-2nd-5-pH9	69.93	75.68
D.0826048	VS-3rd-2-pH3	5.65	6.47	D.0826095	VS-3rd-6-pH3	5.41	6.21
D.0826049	VS-3rd-2-pH5	1.84	2.35	D.0826096	VS-3rd-6-pH5	1.62	2.11
D.0826050	VS-3rd-2-pH7	8.43	9.47	D.0826097	VS-3rd-6-pH7	3.13	3.74
D.0826051	VS-3rd-2-pH9	12.46	13.84	D.0826098	VS-3rd-6-pH9	29.96	32.79
D.0826052	VS-2nd-2-pH3	117.83	127.90	D.0826099	3rd TCLP; #1-2	0.46	0.00
D.0826053	VS-2nd-2-pH5	27.91	30.57	D.0826100	4th TCLP; #2-2	0.22	0.11
D.0826054	VS-2nd-2-pH7	27.09	29.75	D.0826101	5th TCLP; #3-2	0.26	0.17
D.0826055	VS-2nd-2-pH9	34.72	37.93	D.0826102	VS-3rd-pH9; RR1	0.72	1.13
D.0826056	VS-3rd-3-pH3	5.61	6.42	D.0826103	VS-3rd-pH9; RR2	1.76	2.25
D.0826057	VS-3rd-3-pH5	32.33	3.06	D.0826104	NO FILE		
D.0826058	VS-3rd-3-pH7	4.77	5.51	D.0826105	VS-2nd-1-pH3-RR1	100.24	108.80
D.0826059	VS-3rd-3-pH9	15.44	17.07				

Note: D.0826076 to D.0826180 were run to test the lab's water.

Appendix C
QC Data

All QC data is listed in the following tables.

Table C-1. Leadville, CO Original Sample QC Data

Leadville, CO Original Sample - see Table 3-4		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
10.000g/100mLs digested	digestate #4, mg/kg dry basis	196.4	6.025	<0.01	35.26	7935	174	4.66	9.59	4.95	273.7
	Blank before #4, ppm	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
available QC info for #4 & raw ICP data	ppm in digestate #4	19.64	0.6025	<0.001	3.526	793.5	17.4	0.466	0.959	0.495	27.37
	ppm in digestate #1	2.38	<0.001	<0.001	0.149*	47.97	0.517	<0.001	<0.002	<0.004	2.324
Preliminary digestions	ppm in digestate #2	1.878	<0.001	<0.001	0.229*	65.24	0.954	<0.001	<0.002	<0.004	2.463
	ppm in digestate #3	2.573	0	<0.001	0.224*	61.92	1.079	<0.001	<0.002	<0.004	2.721
1.000g/100mLs digested											
	digestate #1, mg/kg dry basis	238	<0.1	<0.1	14.9*	4797	51.7	<0.1	<0.2	<0.4	232.4
need to digest larger sample (see #4 above)	digestate #2, mg/kg dry basis	187.8	<0.1	<0.1	22.9*	6524	95.4	<0.1	<0.2	<0.4	246.3
	digestate #3, mg/kg dry basis	257.3	0.4	<0.1	22.4*	6192	107.9	<0.1	<0.2	<0.4	272.1
	Mean #1-3, mg/kg dry basis	227.7	<0.2	<0.1	20.1*	5838	85	<0.1	<0.2	<0.4	250.3
	%RSD**	12.8	-	-	18.3	12.8	28.4**	-	-	-	6.6
QC info for #1-3											
	Blank before, ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
	Ck Std before, % Recovery	104.9	81.9	82.5	137.3*	83.7	97	81.1	90.6	88.7	84.6
	Ck Std after, % Recovery	112.4	87.7	89.3	143.1*	89.9	102.1	87.8	95.7	95.4	89.7
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* Check standard values out of range specified in QAPP, Cu results may be biased (high).
** %RSD ≤20% specified in QAPP.
NS = not specified in QAPP.

Tab;e C-2. Yerington, NV Original Sample QC Data

Yerington, NV Original Sample (see Table 3-4)		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
1.000g/100mLs digested	Sample #4, mg/kg dry basis	1566	26.3	63.3	1766	48770	1630	48.2	156.5	20.7	144.1
raw ICP data for #4	ppm in digestate for #4	15.66	0.263	0.633	17.66	487.7	16.3	0.482	1.565	0.207	1.441
Other samples of same waste that were evaluated before #4 was chosen for use in study	ppm in digestate for #1	28.5	0.395	<0.001	17.94	156	44.94	0	0.084	0.18	0.27
	ppm in digestate for #2	16.33	0.37	0.588	29.12	557.2	18.22	0.658	1.585	0.219	1.758
	ppm in digestate for #3	196.5	0.089	0.05	1.125	256.2	69.89	0.1	0.387	0.742	0.855
1.000g/100mLs digested for #1-2	Sample #1, mg/kg dry basis	2850	39.5	<0.1	1794	15600	4494	0.4	8.4	18	27
	Sample #2, mg/kg dry basis	1633	37	58.8	2912	55720	1822	65.8	158.5	21.9	175.8
2.720g/100mLs digested for #3	Sample #3, mg/kg dry basis	7224	3.27	1.84	41.36	9419	2569	3.67	14.23	27.3	31.43
available * QC info for #1-4	Blank before, ppm	<0.0011	<0.001	0	<0.001	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
	Blank after, ppm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.004	0.111

* No replicates or check standard data are available for these analyses.

Table C-3. Dearing, KS Original Sample QC Data

Dearing, KS Original Sample (see Table 3-4)		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
1.000g/100mLs digested	Mean, mg/kg dry basis	260.8	5.3	N/D	182.4	4080	47.8	10	N/D	13.6	3822
Raw ICP data for 3 samples digested	ppm in digestate #1, df=21	32.28	<0.021	<0.021	25.29	551.4	4.888	<0.021	<0.042	<0.084	538.1
	ppm in digestate #2, df=17	39.97	0.3669	<0.017	28.13	633.9	6.56	<0.017	<0.034	<0.068	599.1
	ppm in digestate #3, df=11	43.27	0.9256	0.1728	28.75	647.5	8.961	1.1	<0.022	0.5897	591.7
Conversion to dry weight basis	digestate #1, mg/kg dry basis	3228	<2.1	<2.1	2529	55140	488.8	<2.1	<4.2	<8.4	53810
	digestate #2, mg/kg dry basis	3997	36.69	<1.7	2813	63390	656	<1.7	<3.4	<6.8	59910
	digestate #3 mg/kg dry basis	4327	92.56	17.28	2875	64750	896.1	110	<2.2	58.97	59170
	Mean #1-3, mg/kg dry basis	3851	<43.78	<7.0	2739	61093	680.3	<37.9	<4.2	<24.7	57630
	%RSD	15	-	-	6.7	8.5	30*		-	-	5.8
QC data	Blank before #1, ppm	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
	Blank before #3, ppm	<0.001	0.035	0.01	0.085	0.075	<0.001	0.148	<0.002	0.052	0.061
	Blank after #3, ppm	0.2061	<0.001	<0.001	0.038	0.075	<0.001	<0.001	<0.002	<0.004	1.431
	Ck Std before #1, % Rec	101.3	94.9	101.1	89.9	100.9	94.2	95.7	88.2**	98.8	92.8
	Ck Std before #2, % Rec	97.1	93.3	100.2	88	100.1	90.6	95.3	91.6	97.6	92.6
	Ck Std before #3, % Rec	109.6	100.8	109.4	89.4	108.6	95.8	104.8	93.6	106	97.7
	Ck Std after #3, % Rec	105.8	98.6	106	89.8	105.8	95.6	101.2	93.5	103.2	96.8
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* %RSD ≤20% specified in QAPP.
** Value slightly outside criteria specified by QAPP.

Table C-4. Leadville, CO TCLP QC Data Summary

Leadville, CO TCLP Data Summary		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
50g dry MPW per liter TCLP	Mean, mg/kg dry basis	457.3	0.39*	<0.04	2.85*	16.89*	22.5	<1.10	7.24*	<0.16	51.38
	% RSD for all 9 measures	2.4	60*	-	186**	21*	3.8	-	38*	-	2.5
Raw ICP data	ppm in TCLP #1 A, 1:2 dil	11.02	0.01	<0.001	0.02	0.335	0.54	0.031	0.068	<0.004	1.272
	ppm in TCLP #1 B, 1:2 dil	11.26	0	<0.001	0.01	0.353	0.59	<0.001	0.201	<0.004	1.305
Three samples extracted (#1-3)	ppm in TCLP #1 C, 1:2 dil	11.35	0.02	<0.001	0.03	0.36	0.575	0.02	0.096	<0.004	1.292
	ppm in TCLP #2 A	22.48	0.016	<0.001	0.05	0.735	1.05	0.019	0.355	<0.004	2.465
	ppm in TCLP #2 B	22.82	0.034	<0.001	0.05	0.764	1.133	0.126	0.524	<0.004	2.518
Three aliquots of extract measured on ICP per sample (A,B,C)	ppm in TCLP #2 C	22.76	0.01	<0.001	0.049	0.786	1.087	<0.001	0.503	<0.004	2.504
	ppm in TCLP #3 A	23.76	0.016	<0.001	0.847**	1.093	1.136	0.083	0.258	<0.004	2.637
	ppm in TCLP #3 B	23.17	0.022	<0.001	0.083	1.042	1.15	0.104	0.427	<0.004	2.61
	ppm in TCLP #3 C	23.53	0.022	<0.001	0.088	1.086	1.161	0.062	0.462	<0.004	2.65
Normalized data for TCLP #1	TCLP #1 A, mg/kg dry basis	440.8	0.2	<0.04	0.8	13.4	21.6	1.24	2.72	<0.16	50.88
	TCLP #1 B	450.4	0.08	<0.04	0.32	14.12	23.6	<0.04	8.04	<0.16	52.2
	TCLP #1 C	454	0.8	<0.04	1.2	14.4	23	0.8	3.84	<0.16	51.68
Precision for TCLP #1 analysis	Mean TCLP #1	448.4	0.36	<0.04	0.77	13.97	22.7	<0.69	4.87	<0.16	51.59
	% RSD for #1	1.52	107	-	60	3.7	4.5	-	58	-	1.3
Normalized data for TCLP #2	TCLP #2 A	449.6	0.32	<0.02	1	14.7	21	0.38	7.1	<0.08	49.3
	TCLP #2 B	456.4	0.68	<0.02	1	15.28	22.66	2.52	10.48	<0.08	50.36
	TCLP #2 C	455.2	0.2	<0.02	0.98	15.72	21.74	<0.02	10.06	<0.08	50.08
Precision for TCLP #2 analysis	Mean TCLP #2	453.7	0.4	<0.02	0.99	15.23	21.8	<0.97	9.21	<0.08	49.91
	% RSD for #2	0.8	62	-	1.2	3.4	3.8	-	20	-	1.1
Normalized data for TCLP #3	TCLP #3 A	475.2	0.32	<0.02	16.94**	21.86	22.72	1.66	5.16	<0.08	52.74
	TCLP #3 B	463.4	0.44	<0.02	1.66	20.84	23	2.08	8.54	<0.08	52.2
	TCLP #3 C	470.6	0.44	<0.02	1.76	21.72	23.22	1.24	9.24	<0.08	53
Precision for TCLP #3 analysis	Mean TCLP #3	469.7	0.4	<0.02	6.79	21.47	22.98	1.66	7.65	<0.08	52.65
	% RSD for #3	1.27	17.3	-	130**	2.6	1.1	25	29	-	0.8

(continued)

Table C-4. Continued

Leadville, CO TCLP Data Summary		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Precision between TCLP extractions	Mean TCLP #1	448.4	0.36	<0.04	0.77	13.97	22.7	<0.69	4.87	<0.16	51.59
	Mean TCLP #2	453.7	0.4	<0.02	0.99	15.23	21.8	<0.97	9.21	<0.08	49.91
	Mean TCLP #3	469.7	0.4	<0.02	6.79	21.47	22.98	1.66	7.65	<0.08	52.65
	Mean TCLP, mg/kg dry	457.3	0.39	<0.04	2.85	16.89	22.29	<1.10	7.24	<0.16	51.38
	%RSD for TCLP #1-3	2.4	6	-	120*	24*	2.7	-	30*	-	2.7
QC data for blanks and check standards for ICP run	Blank before samples, ppm	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
	Ck Std before, % Recovery	103.8	101.5	101.2	94.6	100.4	99.9	103.6	104.1	101.1	100.3
	Ck Std after, % Recovery	104.4	104.1	104.1	107.9	104.3	105.2	105.3	104.7	103	103.2
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* %RSD ≤20% specified in QAPP.
** Note: ICP raw data was not available to double check the italicized value for transcription errors and the value was reported as is; transcription error may be a factor in the high %RSD for this sample.

Table C-5. Yerington, NV TCLP QC Data Summary

Yerington, NV TCLP Data Summary		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
50 g MPW per liter TCLP	Mean, mg/kg dry basis	3086	0.544	5.692	116.4	26.24	249.6			3.333	7.917
	% RSD for #1-3	3.1	13	19	3	5.1	1.2	-	-	2.7	11
Raw ICP data Three samples extracted (#1-3) Three aliquots of extract measured on ICP per sample (A,B,C)	ppm in TCLP #1 A	154.1	0.035	0.3413	5.794	1.38	12.33	<0.002	<0.004	0.2227	0.5772
	ppm in TCLP #2 A	144.5	0.026	0.4272	5.46	1.413	12	<0.002	<0.004	0.2298	0.5276
	ppm in TCLP #3 A	151.5	0.017	0.3368	5.705	1.282	12.43	0.052	0.1647	0.228	0.4879
	ppm in TCLP #1 B	161.3	0.035	0.3413	6.098	1.413	12.91	<0.002	<0.004	0.2369	0.4085
	ppm in TCLP #2 B	152	0.04	0.4453	5.747	1.468	12.79	0.052	0.1647	0.2422	0.2993
	ppm in TCLP #3 B	157.1	0.035	0.3549	5.983	1.336	13	0.052	0.134	0.2298	0.3687
	ppm in TCLP #1 C	160.5	0.018	0.066	6.026	1.179	12.29	<0.002	<0.004	0.037	0.3475
	ppm in TCLP #2 C	151.2	0.022	0.1696	5.675	1.234	12.17	0.052	0.1647	0.043	0.2383
	ppm in TCLP #3 C	156.3	0.018	0.079	5.911	1.102	12.38	0.052	0.134	0.03	0.3077
Normalized data for TCLP #1	TCLP #1 A, mg/kg dry basis	3082	0.7	6.826	115.9	27.6	246.6	<0.04	<0.08	4.454	11.54
	TCLP #1 B	3226	0.7	6.826	122	28.26	258.2	<0.04	<0.08	4.738	8.17
	TCLP #1 C	3210	0.35	1.312	120.5	23.58	245.8	<0.04	<0.08	0.748	6.95
Precision for TCLP #1 analysis	Mean TCLP #1	3173	0.583	4.988	119.4	26.48	250.2	<0.04	<0.08	3.3313	8.89
	% RSD for #1	2.5	3.5*	64*	2.7	9.6	2.8	-	-	67*	27*
Normalized data for TCLP #2	TCLP #2 A	2890	0.522	8.544	109.2	28.26	240	<0.04	<0.08	4.596	10.55
	TCLP #2 B	3040	0.79	8.906	114.9	29.36	255.8	1.044	3.294	4.844	5.97
	TCLP #2 C	3024	0.44	3.392	113.5	24.68	243.4	1.044	3.294	0.854	4.77
Precision for TCLP #2 analysis	Mean TCLP #2	2985	0.584	6.947	112.6	27.43	246.4	<0.71	<2.2	3.431	7.1
	% RSD for #2	2.8	31*	44*	2.7	8.9	3.4	-	-	65*	43*
Normalized data for TCLP #3	TCLP #3 A	3030	0.342	6.736	114.1	25.64	248.6	1.044	3.294	4.56	9.76
	TCLP #3 B	3142	0.7	7.098	119.7	26.72	260	1.044	2.68	4.596	7.37
	TCLP #3 C	3126	0.35	1.584	118.2	22.04	247.6	1.044	2.68	0.606	6.15
Precision for TCLP ## analysis	Mean TCLP #3	3099	0.464	5.139	117.3	24.8	252.1	1.044	2.885	3.254	7.76
	% RSD for #3	2	44*	60*	2.5	9.9	2.7	0	12	70*	24*

(continued)

Table C-5. Continued

Yerington, NV TCLP Data Summary		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
Precision between TCLP extractions	Mean TCLP #1	3173	0.583	4.988	119.4	26.48	250.2	<0.04	<0.08	3.313	8.89
	Mean TCLP #2	2985	0.584	6.947	112.6	27.43	246.4	<0.04	<0.08	3.431	7.1
	Mean TCLP #3	3099	0.464	5.139	117.3	24.8	252.1	1.044	2.885	3.254	7.76
	Mean TCLP, mg/kg dry	3086	0.544	5.692	116.4	26.24	249.6	<0.37	<1.01	3.333	7.92
	%RSD for TCLP #1-3	3	13	19	3	5.1	1.2	-	-	2.7	11
QC data for blanks and check standards for ICP run	Blank before samples, ppm	0.709	<0.001	0.2124	0.071	0.2065	0.5446	<0.002	<0.004	0.1639	0.4581
	Blank after A&B, %Rec	0.9161	0.035	0.3549	0.073	0.2723	0.7506	0.1797	0.019	0.2422	0.061
	Blank before C, ppm	0.7682	0.018	0.2758	0.072	0.234	0.6156	<0.002	<0.004	0.1995	0.061
	Ck Std before A&B, % Rec	125.8†	65.85†	91.54	23.52**	80.84	32.32†	82.45	44.85**	80.35	52.22**
	Ck Std after A&B, % Rec	135.8†	71.29†	99.18	25.45**	87.53	35.42†	89.85	49.67**	86.81	55.95**
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* %RSD ≤20% specified in QAPP.
** % Recovery values exceed limits specified in QAPP.
† Not specified in QAPP, but results atypical for these elements.

Table C-6. Dearing, KS TCLP QC Data Summary

Dearing, KS TCLP Data Summary		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
50g dry MPW per liter TCLP	Mean, mg/kg dry basis	4805	30.46	<0.103	70.92	18.76	230.5	8.478	6.185	<0.138	10120
	% RSD for #1-3	2.5	1.8	-	1.4	156*	0.7	2.2	30*	-	1.3
Raw ICP data Three samples extracted (#1-3	ppm in TCLP #1	244.8	1.541	0.013	3.494	2.631	11.62	0.4345	0.3757	0.013	509.5
	ppm in TCLP #2	242.4	1.492	<0.001	3.553	0.1078	11.46	0.4186	0.2031	<0.004	510.3
	ppm in TCLP #3	233.6	1.536	<0.001	3.591	0.075	11.49	0.4186	0.3489	<0.004	498.8
Precision between TCLP extractions	TCLP #1, mg/kg dry	4896	30.82	0.269	69.87	52.62**	232.4	8.691	7.515	0.254	10190
	TCLP #2	4848	29.84	<0.020	71.06	2.156	229.2	8.372	4.062	<0.080	10210
	TCLP #3	4672	30.72	<0.020	71.82	1.498	229.8	8.372	6.978	<0.080	9976
	Mean TCLP #1-3, mg/kg dry	4805	30.46	<0.103	70.92	18.76	230.5	8.478	6.185	<0.138	10120
	%RSD for TCLP #1-3	2.5	1.8	-	1.4	156*	0.7	2.2	30*	-	1.3
	Blank before samples, ppm	<0.001	0.07	0.013	0.1696	0.1498	<0.001	0.2956	<0.002	0.104	0.1221
	Blank after samples, ppm	0.2061	<0.001	<0.001	0.038	0.075	<0.001	<0.001	<0.002	<0.004	1.431
QC data for blanks and check standards for ICP run	Ck Std before, % Recovery	109.6	100.8	109.4	89.4	108.6	96	104.8	93.6	106	97.7
	Ck Std after, % Recovery	105.8	98.6	106	89.8	105.8	95.6	101.2	93.5	103.2	96.8
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* %RSD ≤20% specified in QAPP.
** Note: Italicized datum was checked on ICP print out and verified.

Table C-7. QC Data for Leadville, CO - Constant pH 5.0

QC Data for Leadville, CO Constant pH 5.0		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
QC data for Table 4-4	Blank before samples, ppm	0.5611	<0.001	0.1853	0.052	0.1791	0.4388	<0.001	<0.002	0.1515	0.0114
	Blank after samples, ppm	0.9901	0.044	0.3752	0.078	0.2888	0.823	0.068	0.1186	0.2565	0.061
ICP run blanks and check standards											
	Ck Std before, % Recovery	111.1	59.8†	82.6*	23.4*	75.4	30.2†	74.8*	40.4*	72.9*	50.7*
No precision data available	Ck Std after, % Recovery	160.0†	84.1	116.6*	29.9*	102.9	41.9†	106.2	59.7*	101.9	65.1*
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* % Recovery values exceed limits specified in QAPP.
† Not specified in QAPP, but results atypical for these elements.

Table C-8. QC Data for Yerington, NV — Constant pH 5.0

QC Data for Yerington, NV Constant pH 5.0		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
QC data for Table 4-5	Blank before samples, ppm	1.034	0.057	0.4024	0.08	0.3162	0.854	0.1159	0.2568	0.2654	0.061
	Blank after samples, ppm	-	-	-	-	-	-	-	-	-	-
ICP run blanks and check standards											
	Ck Std before, % Recovery	163.9†	85.3	118.0*	29.5*	103.9	42.1†	107.3	59.5*	102.9	65.7*
No precision data available	Ck Std after, % Recovery	-	-	-	-	-	-	-	-	-	-
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%

* % Recovery values exceed limits specified in QAPP.
† Not specified in QAPP, but results atypical for these elements.

Table C-9. QC Data for Leadville, CO MPW — Leaching at pH 3, pH 5, pH 7 and pH 9

QC Data for Leadville, CO MPW Leaching at pH 3, pH 5, pH 7, and pH 9		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
QC data for Table 4-7	Blank before pH 3, 5, 7, ppm	<0.001	0.216	<0.001	0.1075	0	<0.001	0	<0.002	<0.004	0.0908
	Blank after pH 7, before pH 9	<0.001	0.1057	0	0.1501	0.095	<0.001	0.1044	<0.002	0.079	0.1419
	Blank after pH 9, ppm	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
ICP run blanks and check standards	Ck Std before pH3, % Recovery	81.8	81	83.9*	88.8	85.1	85.8	78.9	74.4*	83.5	81.1
	Ck Std after pH3, before pH5	98.6	92.6	99.2	90.8	99.2	92.9	93.4	86.2*	97.2	91.2
	Ck Std after pH5, before pH7	101.6	95.7	102.5	90.9	102.2	94.3	96.4	88.6*	100	93.6
No sample precision data available	Ck Std after pH7, before pH9	105.8	98.2	106.1	90.4	105.6	95.2	100.2	90.8	103.4	95.8
	Ck Std after pH9	83.6	82.2	84.8*	86.8	85.8	87.4	80.4	76.6*	84	81.6
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%
Precision for check standards	Mean Ck Std % Recovery	94.3	89.9	95.3	89.5	95.6	91.1	89.9	83.3	93.6	88.7
	% RSD for Ck Std	11	8.8	11	2	10	4.7	11	8.8	9.9	7.7

* % Recovery values exceed limits specified in QAPP.

Table C-10. QC Data for Yerington, NV MPW - Leaching at pH 3, pH 5, pH 7, and pH 9

QC Data for Yerington, NV MPW Leaching at pH 3, pH 5, pH 7, and pH 9		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
QC data for Table 4-8	Blank before pH 3, 5, 7, ppm	<0.001	0.216	<0.001	0.1075	0	<0.001	0	<0.002	<0.004	0.0908
	Blank after pH 7, before pH 9	<0.001	0.1057	0	0.1501	0.095	<0.001	0.1044	<0.002	0.079	0.1419
	Blank after pH 9, ppm	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
ICP run blanks and check standards	Ck Std before pH3, % Recovery	107.6	99.8	107.8	91.5	107	96.9	102.3	92.2	104.8	96.9
	Ck Std after pH3, before pH5	109.6	101	109.5	91.8	108.7	97.6	104	94.2	106.4	98.4
	Ck Std after pH5	110.5	100.6	110	89.8	108.9	96.3	104.4	92.7	106.6	97.8
	Ck Std before pH7	83.6	82.2	84.8	86.8	85.8	87.4	80.4	76.6	84	81.6
No sample precision data available	Ck Std after pH7, before pH9	97.5	91.8	97.2	89.3	97.3	92.7	92.4	85	95.4	89.8
	Ck Std after pH9	101.3	94.9	101.1	89.9	100.9	94.2	95.7	88.2	98.8	92.8
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%
Precision for check standards	Mean Ck Std % Recovery	101.7	95	101.7	89.8	101.4	94.2	96.5	88.2	99.3	92.9
	% RSD for Ck Std	10	7.7	9.6	2	8.8	4	9.6	7.5	8.8	6.9

* % Recovery values exceed limits specified in QAPP.

Table C-11. QC Data for Dearing, KS MPW — Leaching at pH 3, pH 5, pH 7 and pH 9

QC Data for Dearing, KS MPW Leaching at pH 3, pH 5, pH 7, and pH 9		Ca	Cd	Cr	Cu	Fe	Mg	Mo	Se	V	Zn
QC data for Table 4-9	Blank before all samples, ppm	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.002	<0.004	<0.0005
	Blank after all samples, ppm	<0.001	0.035	0.01	0.085	0.075	<0.001	0.1478	<0.002	0.052	0.061
ICP run blanks and check standards	Ck Std before pH3, % Recovery	101.3	94.9	101.1	89.9	100.9	94.2	95.7	88.2*	98.8	92.8
	Ck Std after pH3, before pH5	97.1	93.3	100.2	88	100.1	90.6	95.3	91.6	97.6	97.6
	Ck Std after pH5,before pH7	104.9	98	105.2	89.8	104.8	95.2	100.4	91.4	102.4	95.1
No sample precision data available	Ck Std after pH7, before pH9	106.4	99	106.2	89.6	105.9	95.7	101.6	98.8	103.6	96.8
	Ck Std after pH9	109.6	100.8	109.4	89.4	108.6	96	104.8	93.6	106	97.7
	Limits in QAPP, 100±?%	NS	NS	±10%	±25%	NS	NS	±25%	±10%	±25%	±25%
Precision for check standards	Mean Ck Std % Recovery	103.9	97.2	104.4	89.3	104.1	94.3	99.6	92.7	101.7	96
	% RSD for Ck Std	4.6	3.1	3.6	0.9	3.4	2.3	4.1	4.2	3.4	2.2

* % Recovery values exceed limits specified in QAPP.

Table C-12. QC Data for Arsenic Results

	Sample ID	Low conc, ppb	High conc, ppb	Mean, ppb	%RPD
Precision data for As	VS-2nd-4-pH3	208.93	226.5	217.72	8.1%
	VS-2nd-4-pH3 dup	191.04	207.2	199.12	8.1%
	VS-2nd-4-pH3 dup2	199.93	216.8	208.365	8.1%
	Mean	208.4			
	%RSD	4.5%			
	VS-2nd-5-pH5	27.87	30.52	29.2	9.1%
	VS-2nd-5-pH5	23.61	25.92	24.76	9.3%
	Mean	26.98			
	%RPD	11.6%			
Accuracy data for As	250 ppb Cal Std	249.7	270.6	260.15	8.0%
	% Recovery	99.88%	108.2%	104.1%	
	125 ppb Cal Std	126.04	136.8	131.42	8.2%
	% Recovery	100.8%	109.4%	105.1%	

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